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Conferences, Expositions

USSR Academy of Sciences Annual Meeting on 1988 Accomplishments

Marchuk Opening Remarks

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[Speech by President of the USSR Academy of Sciences Academician G. I. Marchuk at the Annual General Assembly of the USSR Academy of Sciences on 11 April 1989 under the rubric "The Annual General Assembly of the USSR Academy of Sciences": "The Opening Remarks of President of the USSR Academy of Sciences Academician G. I. Marchuk"]

[Text] The year under review was a year of the practical implementation of the program of the perestroyka of the economic, political, social, and spiritual life of Soviet society. The 19th All-Union Party Conference, in conformity with the decisions of which the implementation of political reform was begun, marked an important turn in the process of the all-round modernization of our society. Perestroyka encompassed all spheres of our life. Changes were made in the USSR Constitution, the new Law on Elections, on the basis of which the elections of USSR people's deputies were conducted, was passed. Democracy and glasnost are gathering strength, the initiative of the people is being unleashed. The improvement of international relations is continuing. The new political thinking is paving the way.

If we return for a moment to the still quite recent past, we will undoubtedly find how substantially our individual and social consciousness has changed. The concept of perestroyka has taken in the previously unclaimed potential of scientific and social thought. The modernization of social practice is proceeding in all directions.

But perestroyka is uncovering newer and newer problems. This, of course, also determines the crucial tasks that have been posed for basic science—both in the creation of the prerequisites of scientific and technical progress and in the promotion of social, political, and cultural development.

It is necessary to note that the increase of the role of basic research is one of the serious results of perestroyka. This was spoke about in the report at the 19th All-Union Party Conference. A number of important decisions of the party Central Committee and the government, which are connected with the strengthening of the material base of the Academy of Sciences, also testify to this. To achieve in a short time the attainment of leading positions in the most important directions of basic research—that is our goal, and on this basis we should implement a program of the socioeconomic reorganization of Soviet society. Thus, two main tasks face us: the improvement of the political system and the extension of economic reform.

On the agenda of today's assembly there are no general questions of the development of science and no general problems, which have accumulated here; we spoke about this after the 19th All-Union Party Conference. Today we should discuss the results of the work of the Academy of Sciences during 1988 and look at the future. In this connection it is necessary to dwell on the basic directions of the perestroyka of its activity. Precisely these questions have often been raised in recent times by the scientific community, the creative intelligentsia, and the mass media.

The questions of increasing the effectiveness of basic research, for example, became a subject of pointed debates. The atmosphere of glasnost and heightened attention to all spheres of social life and the one-sidedness in the coverage of the problems of science, which existed for many years, aroused increased interest in the activity of academic scientific institutions and in the state and level of domestic basic research. The extensive discussion of questions, starting with the directions and themes of research, interrelations in collectives, and the correlation of existing achievements with the world level and ending with the reevaluation of the different stages of the development of science in the past and the description of previously little-known details of the dramatic events in the life of the scientific community, led to the formation of a quite mixed picture in social consciousness.

In singling out what is basic and essential, it should be said that in domestic science obstacles, which did not make it possible to hook it up at full power to the solution of the problems being posed by perestroyka, have formed. Due to the disproportions in structural and investment policy, which existed over many past years, the oversights in the development of the material base, and the lack of effective material stimulation of the labor of scientists, the level and dynamics of research, first of all basic research, have decreased noticeably.

Perestroyka is returning to science its status as one of the most important motive forces of social development. The broad, open discussion of problems should prepare the necessary conditions for the improvement of the activity of scientists in the country. In this context it is necessary to note the great importance of the 19th All-Union Party Conference, at which M.S. Gorbachev noted that society is indebted to science.

Over the last 3 years a search for means and forms of the improvement of various aspects of activity has been under way at the USSR Academy of Sciences. The broadest range of questions, which concern the activity of academic institutions and the management, planning, and financing of basic research, are being discussed at the general assemblies and the meetings of the Presidium. In the process of implementing various innovations they are constantly being adjusted with allowance made for gained practical experience.

The new events and problems urgently require discussion and solution. Let us take, for example, interethnic relations. Here the constructive proposals of scientists are urgently needed. The problem is a chronic one, and this is a result of the fact that the national question was for long years considered settled in our country. The USSR Academy of Sciences and the republic academies are already working in this direction, but it is necessary to increase the pace of our research substantially.

There is another question. A new agrarian policy has been formulated in the country. It also marks a new stage of the work of our collectives. Scientists should join in the common creative labor on the accomplishment of the food program. I would like to point out one thing here. At a conference in the party Central Committee one of the chairmen of kolkhozes said: we understand that the path, which has now been chosen, is the path which is aimed at changing the attitude toward land and toward labor. Along with kolkhozes and sovkhozes the family contract, various types of cooperation, and the leasing contract should be developed. Let scientists also help to develop such an economic system, which would aid the good interaction of all forms of management. We need to direct attention to this. We are not only engaging in basic research, but are also living for the life of our society and for its vital needs.

Many questions have been raised during the radical economic form. Here there are both the development of the cooperative movement and the problems of combining the market and the plan and many other questions. The entire country is learning to work under the new conditions, while moving ahead and correcting the deviations or mistakes that have appeared. In essence, an intense search for correct solutions and the struggle of different opinions and views are taking place. All these processes also directly affect the sphere of academic science and are constantly posing new tasks for it.

Our assembly is one for hearing reports. Consequently, it is necessary to look back at the past year and to analyze both our achievements and shortcomings and the problems of the development of science. What are the most important scientific results of the Academy of Sciences? The vice presidents and other speakers will answer these questions during their statements; therefore, I will dwell on just a few aspects.

Very important tasks, which are closely connected with perestroyka, faced the social sciences during the year under review. Thus, the research of economics scholars was aimed first of all at the solution of the problem of radical economic reform. Here there are the questions of the perestroyka of management and the development of a new economic mechanism based on the principles of full cost accounting. Our economics scholars were enlisted in the formulation of the concept of radical economic reform. Here academic institutes specified the methodological principles of the formation of the mechanism of balanced reproduction on the basis of the fundamental combination of the plan and the market and proposed a new concept of centralized planning, which includes the transfer of functions of the center to other levels. Economics scholars of the USSR Academy of Sciences and the academies of the union republics formulated the concept of the complete economic independence of the union republic, and these material were taken into consideration when elaborating state decisions.

The substantiation and forecasts of the socioeconomic development of the country, about which we spoke in detail at the October session of the General Assembly, took up much space in the research of scientists. In this research the basic principles of the provision of the Concept of the Socioeconomic Development of the Country During 1991-2005 were formulated and the basic provisions of the Comprehensive Program of Scientific and Technical Progress of the Country for 1991-2010 and republic comprehensive programs of scientific and technical progress were formulated. It is necessary to particularly note that our major elaborations in past years, as a rule, did not reached the consumer. They were used most often as reference material, not as a foundation for the formulation of policy. The concept of the development of the national economy is now being developed on the basis of documents that academic and sectorial institutes prepared. This is a major achievement of our economic science.

The following work should also be noted: in a short time a collective of authors prepared and published the textbook "Politicheskaya ekonomiya" [Political Economy] for higher educational institutions. A recently published work on the problems of the political economy of socialism is also interesting. As you see, scientific thought is generating important works. They are necessary for the education of a broad group of people.

Scientists of the Problems of World Economics and International Relations Department, which was established last year, are devoting basic attention to the elaboration of various aspects of the new political thinking and to the revision of the views on the problems of the cooperation of states and the formed stereotypes in international relations. Practical recommendations on the development of the concept "the all-European house" were formulated.

Within the framework of the Comprehensive Program of Scientific and Technical Progress for the Period to 2010 research was performed on the forecasting of the socioeconomic and the scientific and technical development of nonsocialist countries and recommendations on the development of foreign economic and scientific and technical relations with foreign countries were formulated.

There are problems that are of value to all mankind, and we also need to get actively involved in the solution of these problems. First of all these are ecological problems, which are close to every person.

Historical science is going through the stage of thorough restoration. Problems, which are connected with global questions of present human existence, face it. The needs of political practice and consciousness, which is being revived, and the internal logic of the development of society predetermined the particular interest in domestic history, first of all of the post-October period. Among the works, which have been prepared at institutions of the History Department, one should name the four-volume "Kratkaya vsemirnaya istoriya" [A Concise World History] and a series of monographs, which are devoted to the formation of the administrative political system of the government of the Soviet state and the description of the peasant economy under the conditions of the policy of "war communism." Studies on the history and present state of national relations in the Soviet Union have been prepared.

Of great importance among the published works are: the first volume of the eight-volume "Istoriya Yevropy s drevneyshikh vremen do nashikh dney" [The History of Europe From the Most Ancient Times to Our Days], a series of works on the history of the Great French Revolution (it was timed to coincide with its 200th anniversary), and the topical work "Sovershenstvovaniye natsionalnykh otnosheniy v SSSR v svete resheniy XXVII syezda partii" [The Improvement of National Relations in the USSR in Light of the Decisions of the 27th Party Congress].

The research in the field of philosophy and law is closely connected with participation in the scientific support of the processes of democratization and the reform of the political system. The efforts of scientists were concentrated around the all-union program "Man, Science, Society: Integrated Research" and the program of the department. They were aimed at the solution of the problems of the harmonization of social relations and the most complete development of the individual under the conditions of socialism which is being modernized. The analysis of the problems of socialist property and cultural heritage was continued. The monographs "Yedinstvo nauchnogo znaniya" [The Unity of Scientific Knowledge], "Chelovek i Zemlya" [Man and Earth], and others were prepared. Let us note at once that an enormous number of unresolved, but vitally important questions exists in the field of philosophy.

In the field of state and law sciences the basic attention of scientists was aimed at the problems of the development of democracy and self-government and the formation of a law-governed state. It is clear that only through it will we achieve a normal rhythm of life of socialist society. In 1988 the underlying concept of the development of socialist self-government in our country was formulated. The work on the development of an up-to-date model of the nation-state structure of the country with allowance made for sociopolitical practice and the new political thinking was continued.

Sociologists, who are conducting studies of the dynamics of the social structure of Soviet society under the conditions of perestroyka, are launching work. The well-known decree of the party Central Committee gave new impetus to the development of this science. The USSR Academy of Sciences, the Academy of Social Sciences attached to the CPSU Central Committee, the All-Union Central Council of Trade Unions, and so are now conducting sociological studies extensively in our country. However, there are still many problems here—it is necessary to improve in earnest the system of the gathering of data on the opinions and moods of groups of the population, to organize the training of sociological personnel at universities, and to improve the services at enterprises. Sociology can fully serve society only when it is capable of providing an objective analysis of the trends that are occurring in life.

One of the main tasks of research in the field of philological science is the generalization of the creative achievements of Russian and Soviet multinational literature. Programs of the publication of classics have been formulated, the work on the complete collection of works of F.M. Dostoyevskiy in 30 volumes has been completed. The development of "Slovar yazyka V.I. Lenina" [A Dictionary of the Language of V.I. Lenin] is of great sociopolitical importance; during the past year the work on the first volume was completed. The four-volume work "Fundamentalnaya grammatika" [Basic Grammar], which gives theoretical support to the preparation of descriptive, educational, and comparative grammars of the languages of the peoples of the USSR, was prepared. In this matter it is important to set up cooperation of academic science with organizations of the State Committee for Public Education. New ideas and concepts are needed, new textbooks are needed. Scientists, especially those of older generations, who have vast experience in such work, should participate in this noble cause.

Let us proceed to the natural and technical sciences.

In the field of mathematics in recent years algebraic and geometric methods have been used extensively in modern mathematical physics. The reverse influence, when problems of mathematical physics stimulated research in the field of algebra, algebraic number theory, geometry, and topology, also seems very important. Thus, in the works of our Leningrad mathematicians on integrable models of quantum field theory new mathematical objects—quantum groups—which, in turn, found new applications in algebraic topology and graph theory and in the most classical sections of model mathematics, were introduced.

In algebraic number theory (I would particularly like to stress this) the complete proof of the Hasse principle for algebraic groups is a most important result—this work was performed at the Belorussian Academy of Sciences. Thereby the series of studies, which were conducted by mathematicians of the Soviet Union, the United States of America, the FRG, and France over the course of

nearly 30 years, was completed and the problem, which was formulated back in 1960, was solved.

In probability theory new unimprovable estimates of the rate of convergence in the central limit theorem in Hilbert space were established. These works also solved a problem, which was posed long ago in world science, and completed a large series of studies.

In the field of information science and computer technology I would like first of all to point out some progress in the development of supercomputers. Here I should mention our most important research efforts on computers with a performance of 100-150 million operations a second, which are being carried out jointly with sectors of the national economy. Scientists of academic institutions showed themselves here to be worthy. Nearly all the developments, which were completed by them, have been accepted by intersectorial commissions. Our supercomputers are original, science and the national economy need them, but thus far the scale of their implementation is negligible.

The need of scientists, engineering and technical personnel, and the entire national economy for personal computers is great. Industry thus far has not set up their production. The situation here is so unsatisfactory that our Nauchpribor Scientific Production Association has begun the production of personal computers for the USSR Academy of Sciences. But, of course, this is a temporary measure. Industry should voice its opinion here, and we are once again asking it this question.

The analysis of the state of affairs in the field of information science and computer technology shows that, in spite of certain gains in several directions of basic research, the tendency to lag behind the West remains and in a number of cases is also growing stronger. Therefore, it is necessary to take steps to correct the situation. The cooperation of specialists of various fields of science and technology is yielding rather good results. Siberians developed a good minicomputer on the basis of cooperation with collectives of the USSR Academy of Sciences and the Ministry of the Electronics Industry. This system was accepted by a commission and was recommended for production. An important contribution to the development of automated systems was made by academic institutes jointly with the Motor Vehicle Works imeni I.A. Likhachev. The developed 32-bit graphics station is making it possible to increase significantly the efficiency of the labor of engineers in machine building, it is necessary for the automation of scientific research. What is especially important, it is possible to duplicate it and literally in 5 years to increase the level of the automation of design. This is a serious problem, and it must be solved.

The Information Science, Computer Technology, and Automation Department is devoting much attention to the development of the Moscow urban development design center. The active work of a number of collectives of the academy is being performed here. We need to work in even closer contact with Moscow institutes and industry. Our duty and the Moscow City and Oblast Soviets of People's Deputies are appealing to us for this. In reality, this center is a testing ground: our basic research is being implemented here. It is clear that such cooperation goes beyond the central region, its results are important for the entire country

An important change occurred in the development of mathematical simulation. An extensive set of studies of great importance was performed. Mathematical simulation is penetrating more and more deeply and extensively all the sectors of the national economy.

Until now we did not have the hardware to develop databases on all the fields of science and technology. Several leading institutes of Moscow, Leningrad, Siberia, the Ukraine, and academies of sciences of the union republics have developed their own databases. This is a very important matter—to store the knowledge that has been accumulated by generations of scientists. And that is why the correct decision was made to allocate the best personal computers, complexes, and the best computer hardware to the collectives which are undertaking to form their own databases. It is important that in this direction we would make a significant spurt, then would develop a unified network, which both institutions of the Academy of Sciences and industry would begin to use. For 1989-1990 this is the most important problem of our organizational and technical development.

Then G.I. Marchuk proceeded to the analysis of the situation in the physical sciences. During the study of the quantum properties of the superfluid phases of liquid helium-3 a new type of superfluidity, which consists in the transfer of the magnetic moment, was discovered and studied. The magnetic analog of the Josephson effect—the phenomenon of quantum interference for a magnetic current—was discovered on a unique unit that makes it possible to obtain record low temperatures.

At the Institute of Atomic Energy imeni I.V. Kurchatov the start-up of the Tokamak-15 unit with magnetic plasma confinement was carried out. It is intended for the obtaining and study of plasma with thermonuclear parameters and the solution of engineering and technical problems of future pilot thermonuclear reactors. The magnetic field in the unit is created by superconducting windings that are cooled to helium temperatures.

At institutes of the General Physics and Astronomy Department of the USSR Academy of Sciences and the USSR Ministry of Health studies of the mechanisms of the interaction of laser radiation with biological tissues and organs were conducted and a wide range of specialized lasers with fiber optic lightguides were developed. All this is making it possible to raise to a qualitatively new level the development of medical and, in particular, surgical technology and instruments. In all 14 laser units, which are equipped with optical lightguides, were turned over to medical institutions.

Scientists of the Estonian SSR Academy of Sciences developed an original method of high-resolution nuclear magnetic resonance in the solid phase.

Research on high-temperature superconductivity, in which tens of institutes of the physical and chemical types are participating, was launched on a broad scale. In this field first, as is known, there was a mighty theoretical "boom," it has not ended even now. Such a triumph of theoretical thought is based on fundamental ideas, which were formulated by scientists of the entire world, including our physicists. The structures and physical properties of high-temperature superconductors were studied, a number of their specimens were introduced in pilot industrial processes. Academic scientific research institutes jointly with institutions of sectors are actively working on these themes. Close international cooperation has also been organized here.

The discovery of new particles—exotic and tensor mesons, the detection of the production of antiprotons in collisions of relativistic nuclei, and the study of the rare decay of a pi-meson into an electron, neutrino, and photon are the most important results in the field of nuclear physics. The work in the field of the neutrino attained the international level. Here our scientists have leading positions. On the basis of the methods of the long-term preservation of ultracold neutrinos, which was developed earlier in our country, the average life of a free neutrino was measured with an accuracy that exceeds the previously achieved accuracy by a factor of 10. This is one of the fundamental constants of physics, and it turned out that this life is equal to 900 plus or minus 11 seconds.

Then G.I. Marchuk proceeded to the analysis of the work in the field of power engineering. Scientists of the Physical Technical Problems of Power Engineering Department conducted research on the substantiation of the new concept of the development of power engineering in the country for the distant future. Criteria were formulated for the evaluation of the versions of the development of the USSR United Electric Power System within the power engineering complex of the country.

The problems of power engineering need very serious interpretation. Here it is important and necessary to take into account the level and reliability of technical equipment and the availability of closed technological cycles and ecologically clean plants. It is possible to say with every right that the future of mankind depends on the state of affairs in power engineering.

A large series of studies was conducted in the field of mechanics, machine building, and control processes. New results were obtained in the development of advanced methods of the optimum design and testing of machines and equipment. Principles and methods of the replacement of metals with composites were developed. In reports at the 27th CPSU Congress, the 19th All-Union Party Conference, and party Central Committee plenums it was stated that machine building is the leading sector of industry, which is ensuring the retooling of our entire national economy. Hence, the fundamental problems that arise here are extremely important for society. It is gratifying that significant new developments exist at the Institute of Machine Science of the USSR Academy of Sciences.

Using the effect of superductility, Moscow and Bashkir scientists developed a technological process of the forming of complex parts made of titanium alloys and the obtaining of a high-strength composite. It seems that here our comrades are paving new roads in science.

The results of the basic and applied research on the problems of machine building, mechanics, and control processes, which was conducted at institutes of the USSR Academy of Sciences, were implemented jointly with sectorial organizations during the development of the Energiya-Buran space rocket complex and the Il-96-300, Tu-204, and An-225 airplanes.

Proceeding to the chemical sciences, G.I. Marchuk noted that in recent times positive changes have occurred in photochemistry and plasma chemistry and in the development of catalysts and composites. A number of important results were obtained in the field of the electronics of organic materials and in the development of new elementoorganic magnetic semiconductors. Original compounds based on polypropylene with a superconducting yttrium ceramic, which display ferromagnetism and microwave absorption, were developed.

In speaking about the successes of chemistry, it should be said that aromatic binders and promising materials for the production of carbon fiber reinforced plastics have been synthesized. A short time will pass and consumer goods will begin to be made of carbon fiber reinforced plastics, which are durable and heat-resistant.

At the Ukrainian SSR Academy of Sciences a new approach to the production of welded components and of construction materials for them on the basis of steels with a given anisotropic structure was implemented for the first time in world practice. This, undoubtedly, is an outstanding achievement.

At the institutes of the Physical Chemistry and Technology of Inorganic Materials Department the principles of the production of fundamentally new metal alloys with an amorphous structure on the basis of intermetallic systems were developed. Such alloys make it possible to increase by 1.5- to 2-fold the service properties of the parts of machines and components.

Several years ago work was begun on ultradispersed diamond additives to oils and compounds of mixtures. It was performed at the Siberian Department of the Academy of Sciences. The time has now come when this research is yielding its results. It seems that this is one of the directions which need extremely great support and require new basic solutions. A new class of materials was

developed—optical porous glasses which are used as matrices for lasers of a new type (solid-state liquid lasers).

While speaking about the research in the field of biology and biochemistry, it is necessary first of all to note the consolidation of the forces of genetics scholars. They held an important all-union conference and drew up the draft of a government decree on the development of work in the field of general genetics. It is characteristic that at our institutes important fundamental problems are taking shape. This is very important. It is necessary to help our geneticists attain the world level in the main, priority directions.

At institutes of the biochemical type a large series of studies of the molecular bases of the functioning of animal cells, particularly kidney cells, was completed. New data were obtained in the development of a cell-free system of the synthesis of protein; the synthesis of globin was accomplished in an extract of animal cells. The work of this level is opening a new stage in the development of biotechnology. We are witnesses of the formation of a new scientific, technical, and technological direction in cell-free biotechnology. This work requires increased attention.

Substantial results were obtained in virology. The complete nucleotide sequence of the genome of the virus of tick-borne encephalitis was established. This work was begun long ago, but most recently it was possible to establish the sequence of the arrangement of genes in the genome of the virus. As a result the possibilities of combating this serious disease are increasing. A fragment of the protein of the virus—a peptide that protects large-horned cattle from becoming ill with foot and mouth disease—was synthesized for the development of a synthetic vaccine against foot and mouth disease.

People of the entire world are expecting from scientists drugs against AIDS. The synthesis of various substances, which are highly active blockers of the reproduction of the virus of the immune deficiency of man in a culture of cells of his blood, was the most important result in the work on this problem. These preparations are hundreds of fold less toxic than the source nucleosides. They were developed at institutes of the USSR Academy of Sciences jointly with scientific organizations of the USSR Academy of Medical Sciences. This work is now of a common human nature, and it is necessary to step it up.

In recent years the Academy of Sciences has been devoting foremost attention to ecological research. It is being conducted by many of its departments and academies of sciences of the union republics. A special General Assembly of the USSR Academy of Sciences was devoted to ecological problems, in 1988 important research on the development of ecologically clean technologies was conducted.

A series of studies on the development of new highly efficient catalysts for the neutralization of the harmful discharges of chemical and metallurgical plants, thermal electrical power plants, and motor vehicles was conducted. A new principle of less expensive and more efficient catalytic systems based on non-noble transition metals for the removal of ecologically harmful impurities from industrial gases of compound composition was developed by petrochemists of the USSR Academy of Sciences. It has been implemented on a pilot industrial scale. Now we are preparing an ecology program. Waste-free technological systems are its core. M.S. Gorbachev spoke in Krasnoyarsk about the necessity of the performance of such work by the USSR Academy of Sciences.

Many of the ecological problems are interconnected, and the work on them is being coordinated by the General Biology Department. As basic works, which were produced in this department, one should name the reference books "Rastitelnyye resursy SSSR" [Plant Resources of the USSR], "Opredelitel nasekomykh Dalnego Vostoka" [A Guide of Insects of the Far East], and others. Much has also been done for the analysis and the forecast of the development of the flora and fauna of the Chernobyl region. It is impossible not to note two other important works of the department. In one of them an ecological evaluation of the transformation of the tundra ecosystems of the Yamal Peninsula at the sites of the development of gas deposits is given, in the other, which is devoted to Lake Baykal, a simulation model of the unique lake was developed.

Proceeding to the earth sciences, it is necessary to begin with seismology. A group of academic institutes completed work on the compiling of a seismic zoning chart of the European Platform for the choice of construction sites of nuclear power plants. This is difficult, painstaking work. After the catastrophic earthquake in Armenia, on the instructions of the Commission of the Politburo of the CPSU Central Committee a seismic zoning chart of Armenia and microseismic zoning maps of the cities and rayon centers, which were destroyed by the Spitak earthquake, were compiled. Work was performed on the specification of the seismicity of the regions and industrial sites of nuclear power plants. On the instructions of the Politburo of the CPSU Central Committee the USSR Academy of Sciences jointly with sectors of the national economy submitted to government organs a program on the substantial improvement of observations and predictions of earthquakes. An automated network made up of five digital seismic stations with the telemetric transmission of data to the National Data Center in Obninsk was set up. They are linked with similar centers of the United States, Canada, Sweden, England, and Australia and in the future will become a part of the seismological network of the world.

Of the works of geologists one should note the search for the presence of petroleum and gas in the southern part of the Siberian Platform and other regions, the recommendations on the directions of prospecting and exploration work, as well as the recommendations that were prepared together with sectorial institutes on the development of the unique petroleum and gas condensate deposits of the Caspian Depression. It is characteristic

that in recent times the approach to the matter of petroleum scientists and geologists has changed. Previously only the resources were the main thing for them. Now they are regarding questions of ecology as of paramount importance.

In recent times in the Geology, Geophysics, and Mining Sciences Department research and development have been successfully conducted in the area of the extraction and concentration of minerals. Thus, a new generation of equipment and technology of the disintegration of ores was developed. The Mekhanobr Interbranch Scientific Technical Complex produced several ecologically clean units. In their characteristics they exceed the world level.

It is well know that our oceanologists in recent decades have made significant gains. Primarily the systematic improvement of the research fleet contributed to this. Last year alone the Mir-1 and Mir-2 manned deep submergence vehicles, which were developed jointly with Finnish specialists and by means of which ancient sulfide ores on the bottom of the Atlantic Ocean were studied, were commissioned. Scientists of the Institute of Oceanology of the USSR Academy of Sciences developed new mathematical models of complex physical processes of differing scale, which occur in the ocean. The foundations of a new scientific direction—the oceanological tomography of the bottom—were laid.

The analysis of the data of comprehensive measurements and theoretical studies of the cirrus cloud cover led scientists of the Oceanology, Atmospheric Physics, and Geography Department of the USSR Academy of Sciences to an interesting conclusion: they showed that cirrus clouds as a whole have a cooling effect on the atmosphere.

Concluding the brief analysis of several results of the research in the field of the natural and technical sciences, G.I. Marchuk noted that during the year under review it was conducted in large volume by institutes of the USSR Academy of Sciences jointly with organizations and enterprises of ministries and departments.

Then G.I. March dwelt on the general problems facing academic science. First of all one should note the increase of the activity of many academies of sciences of the union republics in the area of basic research. The first serious steps in the creative cooperation of the USSR Academy of Sciences with them exist. It is necessary to develop this process, first of all by support with experienced personnel and the strengthening of the material base of research.

Difficult problems have accumulated in the social sphere. While working on them, it was necessary to agree to extreme measures, having transferred assets from the sphere of the capital construction of facilities of science to housing, social, cultural, and personal service facilities, medical service, dormitories, and hotels. These questions require the close attention of both the USSR Academy of Sciences and the academies of sciences of the union republics.

It is well known that certain difficulties exist in the work with contracting organizations: construction workers can be taken away from our facilities at any time. Of course, it is necessary to ask the appropriate directive organs not to ignore the vital needs of scientists. On the other hand, we need to develop our own construction base.

Perestroyka has provided a powerful stimulus for the development of all of society, including science. We have taken the first steps in this direction. We have established a system of the replacement of personnel in a democratic manner at all levels—from the laboratory to the Presidium. Institutes now have the opportunity to select themselves the structures which they consider more advisable for them.

The weekly all-union newspaper POISK, which is an organ of the USSR Academy of Sciences, the USSR State Committee for Public Education, and the Central Committees of the trade unions of workers of public education and science, is to be published starting in May of this year. It seems that subscription to the new publication, which is called upon to become a popular one, will actively take place at institutes and other institutions.

In 1989 the USSR Academy of Sciences received considerable additional allocations for the development of basic research in accordance with all-union programs and the technical base. The concern of the state about the state of affairs in science showed in this. It is clear that there are still many unsolved problems here, not everything here is clear concerning how this process should take place. But it is necessary to act in a new way—by trying, adjusting, and correcting mistakes.

In 1988 we made substantial progress in the organization of international contacts with such countries as the United States, Great Britain, France, the FRG, and others. It is also necessary to improve these contacts further, extending them in the most important directions.

Starting in July of this year the procedure of organizing departures of Soviet scientists abroad and the arrival on our invitation of scientists from other countries is being simplified substantially. All these questions will now be settled in the Presidium of the USSR Academy of Sciences and at the level of our departments.

But many problems still await their fundamental solution. For this purpose we addressed to the CPSU Central Committee proposals on the further development of basic science. A favorable decision was made on this question, although the preparation of this document should be accompanied by a very detailed analysis. The Presidium of the Academy of Sciences also considers it necessary to submit these questions for extensive discussion by the public, having published them in the press and having discussed them at the forthcoming all-union conference of scientific personnel.

Then G.I. Marchuk reported that the term of office of the Presidium of the USSR Academy of Sciences and all

the working organs of the departments expires on 15 April of next year. Therefore, it is necessary to prepare for the election.

The all-union conference of scientific personnel will be held in late 1989. It is well known that the corresponding decision on it was made at the 19th All-Union Party Conference. It is necessary already now to focus attention on the unresolved issues and the shortcomings, with which it has thus far not be possible to cope. And, what is the primary thing, it is necessary to look to the future and to outline the means of the progressive development of the USSR Academy of Sciences and its institutions. The election to the USSR Academy of Sciences takes place in December 1989. Therefore, it is necessary to make the most use of the time and to participate in a concerted manner in the joint work. Only in this way is it possible to accomplish the crucial tasks that face Soviet science.

Vice President Osipyan Report

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[Speech by Vice President of the USSR Academy of Sciences Academician Yu. A. Osipyan at the Annual General Assembly of the USSR Academy of Sciences on 11 April 1989 under the rubric "The Annual General Assembly of the USSR Academy of Sciences": "The Report of Vice President of the USSR Academy of Sciences Academician Yu. A. Osipyan"]

[Text] I have to give a brief survey of the achievements in the field of mathematics, nuclear physics, and general physics. However, before speaking about the results, I consider it expedient to analyze in general outline the situation that has formed in the given fields of knowledge. This will make it possible to compare what it was possible to do during the past year with how these fields of science are developing in general.

I will start with mathematics. Domestic mathematics traditionally was and remains very strong. Soviet theoretical mathematics can pride itself on a large contribution to world science. In recent years, which have been marked by global changes in the life of human society, particularly by the extensive introduction of computer hardware, it experienced some difficulties, which are connected mainly with the decline of the prestige of a mathematical education and research activity in the field of theoretical mathematics among young people. However, this crisis, in the opinion of specialists, is gradually being overcome. The prestige of mathematical research in society is beginning to increase, the interest in a mathematical education among talented young people is being renewed.

In recent times the work of scientific research institutes of the mathematical type in our country, particularly of the corresponding subdivisions of the Academy of Sciences, was performed in the name of the implementation of the decree of the CPSU Central Committee and the USSR Council of Ministers on the development of mathematics, which was adopted in late 1986. Several serious measures, which are aimed at the improvement of the conditions and the intensification of the work of Soviet mathematicians, were stipulated in this decree, which precisely now is beginning to be implemented more or less effectively. In particular, the important decision, which was recently implemented by the Academy of Sciences, on the establishment in the Soviet Union of the International Mathematics Institute, was made. Such an institute, which is named after Leonard Euler, was organized in Leningrad. It was also decided to increase the number and circulation of mathematical journals and to raise the stipend for undergraduate students in mathematics and graduate students. The decrees, which are aimed at the improvement of the material and technical base of the mathematics institutes of the Academy of Sciences and other institutions of the mathematical type, contributed to the more efficient organization of the scientific research work of our mathematicians.

Proceeding to the specific achievements in the indicated fields, about which G.I. Marchuk already spoke in part, I consider it necessary first of all to note the important results that were obtained in the field which is traditionally at the meeting point of physics and mathematics. In general the classical arrangement was always as follows: on the basis of achievements of classical theoretical mathematics some abstract problems, which were formulated as equations and relationships, were solved, then the solutions of these equations were applied to the substantiation of specific problems in fields connected with phenomena of nature, initially particularly in the field of mechanics and classical physics, then quantum theory—already in our century, when quantum science began to be developed effectively.

At the same time it has become especially obvious in recent times that along with this the reverse process also occurred. First some simple notion of the physical structure of one or another real object formed. As the properties of this object underwent experimental investigation and analysis on the basis of theoretical physics, new conceptual notions, which passed from physics to mathematics, emerged, and then mathematicians proved to be capable of distinguishing and describing some new class of mathematical objects. After this the problem was worked on at a qualitatively different level: the class of mathematical objects was formulated by mathematicians, their properties were described, and as a result new fields of modern mathematics emerged.

We are witnesses to how important results, which are connected with a new mathematical object—so-called quantum groups—are appearing in Soviet mathematics,

mainly through the efforts of the Leningrad mathematical school which is headed by Academician L.D. Faddeyev (now there is there a recognized leader who is the president of the International Mathematical Union). This is a special and very complex question, and I will not dwell on it, I will merely note that the pattern of the penetration of several physical concepts into mathematics and the formulation of the structure of a new mathematical object appears very clearly here. These results are now universally recognized in world mathematics, they are being discussed intensively at many mathematical congresses and conferences.

The development of research, the start and basic results of which are connected with the name of the recently deceased Academician L.S. Pontryagin, a prominent Soviet mathematician, serves as another example of our mathematical successes. It is a question of the theory of differential equations, of what is now called differential games. This is a section of theoretical mathematics, which is finding broad technical applications in the most different fields, both in the substantiation of the formulation of strategic and tactical aims and when solving specific problems—for example, in problems on how, if necessary, to overtake certain moving objects or in problems on how to avoid collisions between them. The Moscow mathematical school (the Institute of Mathematics imeni V.A. Steklov of the USSR Academy of Sciences), as well as the Ural mathematical school, which is headed by Academician N.N. Krasovskiy and the mathematicians of which have achieved especially important results when solving practical, applied problems, are taking an active part in this work. The achievements of this school, which were also very significant during the past year, are rated highly by specialists.

I will dwell on several results in the field of modern algebra. In the report of G.I. Marchuk it was noted that in algebraic number theory it was possible to offer a complete proof of the Hasse theorem. This was done by the efforts of the Belorussian mathematical school, which is headed by Academician V.P. Platonov and the scientific achievements of which have received international recognition. It is possible to state with gratification that at the Belorussian SSR Academy of Sciences a prominent mathematical school, which enjoys prestige in world science, has formed and is developing successfully. Many scientists of the United States and the countries of Europe are working in the same research field, but the results of the Belorussian mathematicians proved to be pioneering ones here in their breadth and depth and in point of fact are now determining the development of science in the field of algebraic number theory. In connection with this it is a great pleasure to congratulate V.P. Platonov, who in addition was elected a USSR people's deputy from the USSR Academy of Sciences.

Problems, which require their solution, also exist in our mathematics. The problems of computer technology have already been spoken about here. Somehow all of us gradually redirected the problems, which are connected with computers, with personal computers, with supercomputers, to the field of computer technology and information science and are linking all the problems here with the development of just the corresponding departments. This, of course, is correct, for the basic center of gravity in the development of computer technology and information science is precisely here. It now lies in the sphere of a new department, which was established and which under the supervision of Ye.P. Velikhov is working successfully. However, on the instructions of mathematicians I would like once again to direct attention to the fact that without a personal computer the best mathematician will not present the results of his development very effectively, for a long time to come they will be on the way to practical use. Therefore, the supply of leading mathematical institutes with personal computers and all the office equipment, which should be connected to them, is an organizational task of the Presidium. This will pay for itself with interest.

Proceeding to nuclear physics, I would like to say that there are also very many problems here and the situation is quite disturbing.

Nuclear physics is the source of very many methods, which are being used in practically all fields of science. And, unfortunately, at times we are witnesses to how nuclear physics, rather the institutes, which have been attached to these problems, gravitate only toward activity in the area of the use of scientific results in the national economy. This is a very important aspect of activity, but it is entirely capable of being transferred to departments. The Academy of Sciences should focus mainly on the settlement of fundamental scientific questions. In this respect it should be said that after the rapid progress of the 1950's and 1960's during the past 20 years the lag of Soviet nuclear physics behind the world level of development of science has been observed. This lag is connected first of all with the lag of the material and technical base and with the lack of means for processing large information files. The main component of the scientific potential—the skill of personnel—may be lost if people do not have anything to work on. In order to maintain the high scientific potential and to be at the leading level of science, it is necessary to have the technical opportunity at this level to work practically. It must be stated frankly that the interest in nuclear physics among the scientific community and especially young people in recent times was lost to a significant extent. Recently the political leadership of our country adopted important decrees on the intensive development of nuclear physics, elementary particle physics, and physics of the atomic nucleus. This was done 1.5 years ago. A broad program was formulated, and if we succeed in implementing it, nuclear physics will again become a leading field of Soviet science.

There are several causes of the lag. One of them is connected with the fact that nuclear installations are extremely expensive, an enormous amount of construction and installation work is required here, technical efforts, which are at the limit of the possibilities of our

industry, are necessary. Moreover, the basic facilities, for example, a meson-producing cyclotron, electron accelerators, and nuclear reactors, take 20 years and more each to build. Such a situation is simply intolerable. An accelerator proves to be unnecessary 2 decades after designing, because the results, which it is possible to obtain on it, no longer interest anyone, they have already been obtained. Therefore, here we will have to concentrate on a limited number of tools, but such tools that correspond to world achievements. What is meant first of all are colliding-beam proton and electron accelerators, for which our Academy of Sciences has been famous for long years now.

It should be noted that in our times no country in the world can rely only on its own forces. We will also be forced in the next few years to make our plans while basing ourselves on international cooperation. The international division of labor in the field of nuclear physics is an urgent necessity. But so that such cooperation would be mutual, we should have the most advanced equipment if only in one field of knowledge or another, so that foreign specialists would have a reason to come here. Such examples already exist. In particular, the Baksan Neutrino Station is a unique facility. We have a unique system for counting particles with the use of a large amount of ultrapure gallium. The cost of this detector is simply astronomical. Along with the Serpukhov accelerator and the colliding-beam positron accelerator this installation is our national reserve.

Further, specialists in elementary particle physics obtained this year results that are important experimental confirmation of several fundamental models of matter. As is known, there is the unified theory of electromagnetic and weak interactions. Its conclusions need experimental confirmations. Last year one of these results was obtained at the Institute of Nuclear Research of the USSR Academy of Sciences. The rare decay of a negative meson into an electron, a neutrino, and a photon was studied. It turned out that this experimental fact is another confirmation of the unified theory of electromagnetic and weak interactions. Another example: the discovery of new particles, such as an exotic meson with a mass of 1,917 plus or minus 15. This also confirms the quantum model of the structure of particles.

It must be said that under the very difficult conditions of a shortage of experimental possibilities our specialists, who work in the field of elementary particle physics and nuclear physics, all the same are obtaining world-class results, not to mention the fact that Soviet theorists in the field of elementary particle physics and the structure of matter are recognized leaders in many fields of modern theoretical physics.

Now I would like to dwell on the work of the General Physics and Astronomy Department, to which I myself belong and the situation at which I know better. Unfortunately, here we have lost the leading positions in several fields. This is connected with the lack of methods opportunities. I would particularly like to direct attention to several difficulties of the development of astronomy. Unfortunately, it turned out that astronomy, which also requires large material investments, proved to be the stepchild of physics research. And astronomers are complaining that their methods opportunities are deteriorating. The rate of citation of Soviet astronomers remains excellent only in the fields in which classical methods are used. Many efforts are being spent on the launching of space instruments, but the return from them in the field of astronomy is low.

In our country quantum electronics, especially solid-state quantum electronics and microelectronics, traditionally has been successfully developed. The results of the Soviet school, which is headed by Academicians N.G. Basov and A.M. Prokhorov, are well known. Outstanding results were obtained by the Gorkiy scientific school headed by A.V. Gaponov-Grekhov, who works at the meeting point of electronics and microwave engineering.

A few words about the work in the field of high-temperature superconductivity. This is the field that will not be developed successfully without close contacts between physicists and chemists. The synthesis of new materials is necessary. Incidentally, this year we allocated nearly all the foreign currency, which was earmarked for this field, for the development of chemical technology operations. We hope that chemists, who are supported with tools, will be able to participate actively in the synthesis of new materials. It seems that 1990 will be successful.

During the study of new semiconductors pioneering results were obtained in crystallography, in the study of the twinned magnetic structure and anisotropy of conduction, as well as during the study of nuclear magnetic resonance.

There is another field, on the threshold of which all of us stand: cold thermonuclear fusion, electrochemical fusion. The latest information, which has appeared in the press, is of a sensational nature: thermonuclear fusion, a thermonuclear reaction, which leads to the release of energy, occurs in the electrochemical process during the electrolysis of heavy water. Here it will also be impossible to make progress without the close contact of specialists in chemistry, solid-state physics, and nuclear physics. The understanding of this problem might lie precisely at the meeting point of these fields of knowledge.

And, finally, about "hot" thermonuclear fusion. Unfortunately, the situation with this program at our academy is bad. The pooling of the forces of the academy and the corresponding ministries is necessary here.

Vice President Velikhov Report

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[Text] I want to begin with the question of what prospects we have in the matter of supplying electronic computer hardware, first of all personal computers. We have established the Kompan joint firm. It is not taking away the capacities of a scientific production association and is functioning like all the joint firms with the FRG. The idea is to assembly from component equipment (mainly western) a personal computer based on a microprocessor like the Intel-286 or Intel-386. Imported components cost about 1,000 foreign currency rubles. And that is why Kompan should earn this foreign currency in some other manner, in order to turn over a portion of the computers to the academy without using foreign currency, which in general it is doing, but not on such a scale as was expected.

Our draft of a decree, in which we ask that we be permitted to use various types of barter contracts, has been in the USSR Council of Ministers for half a year. I believe that in the end the draft will be accepted.

Perhaps, you have ideas or there will come to you ideas on how to earn this small amount, then we will have these computers. This is not simply assembling, this is immense work on operation-by-operation and outgoing control, since we want to have a reliable product. And the firm can do such work and supply any number of computers, provided we will be able to pay some share of the foreign currency.

The second part of the problem is automated workplaces, or workstations. It is a more serious and tenfold more expensive matter. You are acquainted with the workstation, many people have seen it. The Academy of Sciences did not expend its own forces and assets. This is being done at the sites and by the forces of the ZIL Production Association. But we have the right to these stations. However, further a question again arises: it is necessary to earn 10,000 foreign currency rubles, then the stations will cost us approximately one-fourth to one-third as much.

The stations are equivalent in performance to a computer like the VAX. And it is a question of very serious reductions of foreign currency allocations, if we take this path. They are standard. They operate on the VME standard European bus and use standard international software based on the UNIX operating system; therefore, everything, which will be done on them, is transferable to all other stations with the same operating system. Consequently, the system of the sale of our software abroad is simplified. We expect that workstations will play a substantial role in our supply with our own means of computer design and the automation of scientific research. The question comes down to the acquisition of components.

It is natural that we are performing work with the Ministry of the Electronics Industry. Today a significant achievement of the ministry is the fact that it has announced the completion of the work on a 32-bit chip set, and we expect, having developed the corresponding integrated circuits, to put this chip set in the same standard bus. Then we will sharply improve the situation with the price. But the price once again is formed far from only from the cost of microprocessors, but from many other elements which are needed for this advanced hardware. These are disk and magnetic tape storages, which make it possible to work at a high level. It is with this that we began the transition to a new level for the supply of the academy with standard computer hardware following the CAMAC standard. In all 80 modules of direct connection with experimental devices and the corresponding network device have been developed, its production has been started at an experimental plant of scientific instrument making in Chernogolovka. Thus, in the area of electronic equipment we are coming out at the next stage of the provision of scientific work with standard equipment following CAMAC.

Finally, the third thing. The collective-use center of the USSR Academy of Sciences, which is headed by Corresponding Member of the USSR Academy of Sciences V.S. Burtsev, is prepared to provide services on work on the Elbrus computer. A dual-processor Elbrus (25 million equivalent operations a second) is available here. The center is prepared to handle major problems, which it is then possible to reduce to a detailed solution by means of the above-mentioned microprocessor systems.

The next thing is the question of competitions. The Information Science, Computer Technology, and Automation Department was charged to carry out the competitive allocation of resources. We allocated specially for competition approximately one-third of all the assets intended for institutes of the department. About 600 designs, on the order of 350 from the union academy and 250 from the regional academies, were submitted for the competition. About 300 experts were enlisted. And we tried to take world experience into account, in particular, not to allow a conflict of interests and lobbying. It is impossible to say that we completely succeeded in this, 40 percent of the opinions of the experts did not coincide with the final decision of the commissions. In the future it is probably necessary to correct this. But the most unpleasant thing was that as a result the money was devalued somewhat due to the decrease of the standard of the wage by up to 2.5 percent.

Moreover, a competition on information technologies was held in the USSR State Committee for Science and Technology. The principle is the same, and there a number of academic institutes also additionally obtained through competition approximately 10 million rubles. It seems to me that this is a normal system, which is very important in principle, and we should perfect it. This is a normal system of the financing of basic operations, first of all because it is attached to a person, to a group, it stimulates activity.

Now a few words about organizational questions. Last year much was done to bring the results of work on microelectronics up to the demonstration level. And the work here is very interesting. Eight academic scientific technological centers were established over 5 years. These are the centers of the Academy of Sciences in the Lithuanian SSR, in Leningrad under Academician Zh.I. Alferov, which is oriented toward microstructures and semiconductor lasers, in Moscow (the newly established Physical Technological Institute, the Institute of General Physics, and the Institute of Radio Engineering and Electronics), and, finally, in Novosibirsk, Yaroslavl, and Moscow Oblast. At the Physical Technological Institute significant gains were made in the area of laser lithography, the corresponding technologies were developed, and a photoresist, which makes it possible to obtain structures measuring on the order of 0.3 micrometer with a ratio of this dimension to the height (depth) of the structure of up to 1:10, was developed. This makes it possible to expect that given such a technology it is theoretically possible to develop a very large-scale integrated circuit with a memory capacity on the order of 100 megabits or on the order of 1 million gates per chip. The assimilation of the technology of the metallization of the last two layers of gate-array chips is one of the tasks of the Institute of Microelectronics in Yaroslavl.

The next question concerns the decrease of the radiation wavelength in the processes of microlithography. These are X-ray sources of synchrotron radiation. Here the most interesting results were obtained by the Institute of Problems of Microelectronics and Ultrafine Materials Technology in Chernogolovka.

Tests of X-ray optics of a new type based on Bragg-Fresnel elements under the conditions of transverse and conical diffraction were conducted. The phase focusing of synchronous radiation with a wavelength of 0.1 nanometer and an efficiency of 15 percent was carried out on shaped crystalline structures. This is giving hope that we will also be able to make substantial progress in the area of X-ray lithography. Such sources are now being developed.

There is a significant technological innovation, about which it is important to know: we have, at last, assimilated pyrolytic boron nitride, which is making it possible to obtain crucibles for molecular beam epitaxy.

Now about the external memory of computers. Definite gains exist in the Ministry of the Electronics Industry, to which we are giving some assistance in the area of optical and two-way magnetooptic disk memory. And we hope that in the near future the first devices will be demonstrated.

In the Cybernetics Council work on the recording of information in the form of linear holograms is being performed jointly with the Ministry of the Chemical Industry. It is natural that a system of this sort can provide added information density.

I should say that a very interesting principle of the recording and storage of information was formulated under the supervision of Academician K.K. Rebane. Last year the possibilities of using for this the burning on of spectral lines, which makes it possible to increase by an order of 10 cubed the density of the recording, registering it as a spectrum, increased substantially. This is making it possible to record four-dimensional holograms in memory.

Finally, about computer-aided design systems. Progress is possible here only if researchers, and not just industry, actually have a system of the automatic design of large-scale integrated circuits. And here we had the most significant lag behind the West. A model of a computer-aided design system and the corresponding library, which makes it possible to design very large-scale integrated circuits with a capacity on the order of 20,000 gates per chip, have now been developed at the Institute of the Automation of Design jointly with the Almaz Scientific Production Association. The architecture, the logic, and control and diagnostic tests of the parallel pipeline Fourier processor were developed on this basis. Its speed is 10 to the twelfth special operations a second. G.I. Marchuk spoke about this design. It was made on a base gate-array chip. And special microcircuits, which make it possible to use a 32-bit microprocessor in the VME system for our scientific development and workstations, were made on the same chip.

The second computer-aided design system of broad application was developed by Corresponding Member of the USSR Academy of Sciences B.V. Batalov together with the Ministry of the Communications Equipment Industry. By means of it we can also make custom and specialized large-scale integrated circuits.

The base version of a computer-aided design system of matrix large-scale integrated circuits with a capacity of up to 10,000 gates per chip was developed at the Institute of Problems of Computer Technology of the USSR Academy of Sciences.

To what G.I. Marchuk said about the development of computer hardware I can add that in industry the duplication of the machines developed by us "is being held up." Definite efforts are being made. But a fact is a fact.

At the Leningrad Institute of Information Science and Automation of the USSR Academy of Sciences work was continued on the development of machines with a dynamic architecture. The approximate performance is

110 million operations, which are equivalent to instructions of the Unified System of Computers, per second. At the Computer Center of the Siberian Department of the USSR Academy of Sciences highly parallel algorithms and computational structures were developed for the solution of the basic problems of digital signal processing. The obtained structures, which satisfy the basic requirements of very large-scale integrated circuit implementation, are characterized by a very high processing speed. The operating part of the 32-bit microprocessor with the KRONOS instruction set was designed and is being introduced jointly with the Kristall Production Association in a microprocessor version. A multiple-user, multitasking operating system for KRONOS processors was developed. This is another system that we need for workstations.

At the Collective-Use Computer Center of the USSR Academy of Sciences the Program of the Basic Directions of Basic Research and Development on the Creation of the Optical Supercomputer of the USSR Academy of Sciences (OSVM) was developed. Here we had an interruption in financing. The State Committee for Science and Technology thus far has not allocated the corresponding resources. I believe that this matter will be settled in the immediate future.

If we talk about machines, I would direct attention to the following circumstance. At one time an intermediate computer with a set of macropipelines was developed on the initiative of the Institute of Space Research. It is being produced in Bulgaria. And the Siberian Department is now engaged in the development on the basis of this machine of an even more powerful computer complex with the addition to it of extra microprocessors.

The Institute of Cybernetics of the Estonian SSR Academy of Sciences developed and studied a prototype of an intelligent object-oriented processor, which ensures the processing of data of a complex structure, in the form of a workstation, which includes an input-output computer, a 32-bit host computer, and an object server. It is a question of how we are to produce these machines in sufficient quantity.

And, finally, an important question is networks. At the Institute of Electronics and Computer Technology of the Latvian SSR Academy of Sciences the concept of the Integral-88 network architecture was developed on the basis of the standards of the International Organization for Standardization on the interaction of open systems. This architecture makes it possible to establish associations of territorial and local open-type computer networks.

Jointly with the All-Union Scientific Research Institute of Applied Automated Systems of the USSR State Committee for Computer Technology and Information Science and the USSR Academy of Sciences an interdepartmental distributed system of the automated exchange of information with foreign computer networks and databases on the basis of packet switching, multiprocessor complexes, and local computer networks was established and put into operation. The second section of the working zone of the Akademset [Experimental Computer Network of the USSR Academy of Sciences and the Academies of Sciences of the Union Republics] consisting of eight regions was developed.

It must be said that we developed a massive Akademset and it is necessary to modernize it. But the appearance of personal computers and the possibility of the appearance of relatively inexpensive modems are affording the possibility of logging on to foreign networks and organizing electronic mail in our country. For the present there are difficulties here, because we do not produce modems. Now we are attempting to organize this business. But for the present it is necessary to buy them.

As a challenge people might say that the collective, which is concerned with school education, now has already organized the logging on of 10 Moscow schools to the world electronic mail network and has linked them up with 10 American schools. The link is operating continuously. It must be seen to that every institute, laboratory, and scientist would have a similar link.

Significant results were obtained at academic institutes of the country in the area of the development of application systems, which have been given elements of artificial intelligence. The concept of the descriptive approach to the recognition and analysis of images was proposed and substantiated in the Scientific Council of the USSR Academy of Sciences for the Complex Problem "Cybernetics." The descriptive approach makes it possible to switch from empirical methods to regular models in the solution of the problems of the recognition and analysis of images during the selection and optimization of information processing algorithms. High performance algorithms for the solution of problems of diagnosis, pattern recognition, and forecasting on the basis of the analysis of precedence were developed and studied at the Computer Center of the USSR Academy of Sciences.

A new software system of the analysis and recognition of patterns (OBRAZ), which was implemented on a YeS-series computer, was developed and introduced. The OBRAZ system was introduced and is being used successfully at the Tsentrprogrammsistem Scientific Production Association, in the Ministry of Civil Aviation, at the Glavtyumenneftegaz Production Association, and at other scientific and production organizations.

A fundamentally new man-machine diagnostic system, which is based on expert knowledge, was developed at the All-Union Scientific Research Institute of Systems Research. This system makes it possible to build large expert knowledge bases, which contain decisive rules on thousands and tens of thousands of diagnosed situations. Several applied medical expert systems for the diagnosis of various diseases, which were turned over for practical use, were developed by means of it.

At the Institute of Information Transmission Problems of the USSR Academy of Sciences methods of the formalization, analysis, and processing of vague expert knowledge and methods of the detection and recognition of objects in multiple-component random fields were developed on the basis of artificial intelligence and mathematical statistics. The indicated developments served as the basis for the creation of the first version of the GEO expert system, which was implemented on personal computers like the IBM PC.

At the Institute of Software Systems of the USSR Academy of Sciences (Pereslavl-Zalesskiy) as a result of joint work with specialists of the Central Scientific Research Institute of Traumatology and Orthopedics the principles of the model of the representation of the knowledge of experts were formulated and the corresponding technology of expert systems, which are convenient and have been checked in medical practice, was developed. Similar work is also being performed at the Institute of Cybernetics of the USSR Academy of Sciences.

I should note if only one interesting task, which was accomplished by the Institute of Applied Mathematics imeni M.V. Keldysh and the Physical Technological Institute. Here the mathematical simulation of submicron transistors on a silicon and arsenide-gallium base was carried out and sets of programs, which take into account the fundamental peculiarities of the zone structure, the specific features of the mechanism of scattering, the charge transfers of traps, and impact ionization under the conditions of a line of locality in the semiconductor materials of the substrates, were developed and used for the study of submicron transistors. In short, a complex, good program, which is making it possible to organize in a new way the entire process of designing and producing transistors, was developed.

The Computer Center of the USSR Academy of Sciences developed very interesting practical programs. They are being used in the planning of machine building complexes, in petroleum production, in the work of the Leningrad Institute of Information Science and Automation of the USSR Academy of Sciences, at the Institute of the Automation of Design, and in the field of architecture and electromechanics. Much work was also performed on the simulation of the ecosystem "The Functions of the Human Body."

The concept of the spread of information technology in Soviet society was formulated. This is a very serious matter. We have the Energy Program, but thus far we have not had a program of the spread of information technology in the country. We have to discuss it in the Presidium of the USSR Academy of Sciences and in the General Assembly. Discussion at a meeting of the Supreme Soviet is also being proposed. All the members of the academy will receive three drafts of the concept, which were formulated by different groups of specialists.

The physical technical problems of power engineering. Our power engineering is an enormous system. At the beginning of 1988 the installed capacity of electric power plants came to 340 million kilowatts. The generation of electric power exceeded 1.5 trillion kilowatt-hours. The consumption of electric power per person comes to 5,500 kilowatt-hours a year, which corresponds to the level of the highly developed European countries.

A large number of practical achievements also exist in the area of the development of large power-generating units, particularly in Kostroma (1.2 million kilowatts). True, we now know that this is not always good, but in this case the decision is correct. A 1.5 million kilowatt reactor is operating on the Ignalina River. The tension in the main alternating current power transmission lines is now 500-700 kilovolts, this is the world level, while in the direct current lines it is 1,150 kilovolts. This is the highest achievement.

In spite of the mentioned gains, we have major problems. Our national economy is developing under the conditions of the increase of power consumption. Yes, there was a time when with the increase of power consumption the national income grew. Now the situation has changed. In developed countries the trend is now different: the curve of the national income has separated from the curve of the increase of the consumption of electric power. The former is ascending, while the latter is descending. In the USSR this does not exist so far.

We now have a good energy program, we have turned it over to the State Planning Committee, but the distance from the program to its implementation is large, since the development of the infrastructure and the financing of the outlined measures are required. Whereas we spend about 1,000 rubles on the production of 1 ton of fuel, it is necessary to spend 60 rubles on the saving of fuel, and not nothing, as it was believed until now, when many people thought that it is sufficient simply to plan energy conversation, without allocating assets for this and without creating an infrastructure. Some changes exist, but they are very small ones. It is feared that given such a pace of the development of work not only will we not be able to separate the above-mentioned curves, but the 1.5 billion tons of equivalent fuel, which we should save by 2005, are also out of the question.

The questions of the development of nuclear power engineering should be examined against this background. Here the main problem is safety. What type of reactor is it necessary to develop? Is it possible to develop such a reactor that will be completely self-protected? It is necessary to use the experience of the so-called nuclear heat supply plant, it is one of the safest in the world, if not the safest; it is necessary to use the experience of liquid-metal or gas reactors. Thus, an expert estimate indicates that it is possible to develop a reactor of this sort, which is ready for commercial use, by 2010-2020. But until this time we should use water-cooled water-moderated reactors, which were developed

and are being used in our country and at which we should obtain on the order of 80 million kilowatts of electric power, with allowance made for the fact that in the immediate future we should take 14 first-generation units out of service.

On the basis of second- and third-generation reactors we should also ensure the increase of capacities.

Here we also need to develop other directions as much as possible. And first of all gas turbines. At one time we were pioneers here. Now we are producing the first units, but these are only low-temperature (950 degrees Celsius) turbines. But we need high-temperature, combined units. Gas will give us some breathing space. In foreign countries similar units are being produced with a high efficiency (over 50 percent) and are completely automated. It is necessary to perform work more purposefully in this direction.

Definite gains exist in the field of thermal physics and in the development of catalysts and purification systems. In industry big problems exist here, in science a certain reserve of the development of inexpensive catalysts has been created.

Now the concept has been developed, and soon the new energy program, which is called upon to unite all the mentioned problems, will be discussed.

I cannot evade another question. You know that the Academy of Sciences actively engaged in the development of magnetohydrodynamic generators. We should have built the Ryazan Power-Generating Unit. Its steam turbine section, which is providing 300 megawatts, is operating, but difficulties have arisen. During the designing it turned out that at the present level of knowledge it is impossible to develop a large number of unique elements without having exceeded the level of risk, which is permissible for an industrial facility. In this connection there were a large number of commissions. In the end the USSR Academy of Sciences jointly with the USSR State Committee for Science and Technology, the Ministry of Power and Electrification, and the Bureau of the Council of Ministers for the Fuel and Power Complex came forth with the proposal on the temporary halt of construction and the concentration of the efforts of the Institute of High Temperatures on the obtaining of the necessary information, first of all on the operating life of the channel, on the large-scale simulation of the superconducting magnetic system, and on the conducting of experiments on the achievement of the maximum conversion.

At the same time the efforts of the institute should be concentrated on the development of a coal-powered plant, not a gas-powered plant. because gas turbines will excluded any possibility of the use of magnetohydrodynamic generations, if a new power technology system is not devised.

Vice President Frolov Report

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[Speech by Vice President of the USSR Academy of Sciences Academician K. V. Frolov at the Annual General Assembly of the USSR Academy of Sciences on 11 April 1989 under the rubric "The Annual General Assembly of the USSR Academy of Sciences": "The Report of Vice President of the USSR Academy of Sciences Academician K. V. Frolov"]

[Text] A number of questions were examined at the general assembly of the Problems of Machine Building, Mechanics, and Control Processes Department of the USSR Academy of Sciences, which was held the day before. Much attention was devoted to what is hindering the development of basic research in the field of the technical sciences.

First of all I should talk about the training of skilled specialists. This problem was discussed at a joint meeting of the Presidium of the USSR Academy of Sciences and the USSR Ministry of Higher Education, which still existed at that time, and the appropriate decisions were made. However, the Academy of Sciences, its leading scientists, and the specialists of the Problems of Machine Building, Mechanics, and Control Processes Department are poorly influencing the change of syllabuses and the quality of training of the modern engineer, who should master the sum of the achievements and knowledge, which modern science and industry have. Meanwhile, as many specialists believe, higher educational institutions are not coping with this task.

Questions of space research are being discussed extensively in the press and at today's General Assembly of the academy. The members of the Problems of Machine Building, Mechanics, and Control Processes Department propose to examine these questions at an expanded meeting of the Presidium of the USSR Academy of Sciences, in order to enlist the scientific forces of all the academy departments in the elaboration of space problems. These problems already go beyond narrow technical and narrow departmental interests.

The successful development of the technical sciences is being hampered by the traditional methods of planning scientific research, which still dominate at institutes. Such new organizational forms as competition and rivalry when allocating assets for the financing of operations and when compiling plans are being slowly introduced in practice. The need for the improvement of publishing activity, the stepping up of the work of scientific journals, and the rapid publication of an encyclopedia on machine building has been noted.

During the past year scientists of the Problems of Machine Building, Mechanics, and Control Processes Department obtained many new results in the field of

mechanics, materials technology, and automatic control systems. I will tell about several of them, but first I will make one remark. The leadership and scientists of the Academy of Sciences still poorly visualize how to interest industry in innovations. The latest achievements in the development of reliable precision systems of the diagnosis of machines, in the assurance of the safety of the operation of nuclear power plants, and in the designing of power-and-materials-consuming systems as before are being introduced slowly into production. The scientific centers of the Academy of Sciences and the affiliates of the Institute of Machine Science imeni A.A. Blagonravov of the USSR Academy of Sciences in Leningrad, Ufa, Sverdlovsk, Kuybyshev, Saratov, Volgograd, and Gorkiy are taking the first successful steps in this direction.

Some of the main problems of the domestic machine building industry are automation, precision diagnosis, and the optimum structure of control.

An automated machining center with advanced methods of metrology was developed under the supervision of Academician V.I. Kuznetsov. This is essentially a robocar which services machine building production in accordance with an assigned program. The extensive duplication of devices of this sort for the national economy is proposed.

I will mention another two robots with program control, which are already operating reliably. One of them is a walking robot, which is capable of traveling under the conditions of impassable roads, the other robot can perform diverse construction operations, scale a wall, and perform technological operations.

Active research in the area of the strengthening of materials is being continued. Laser hardening, which increases the fatigue and dynamic strength of materials, is being used extensively in the machine building industry. Laser systems are being used as guides of high-precision machine tools. At the Krasnyy proletariy Plant scientists of the Academy of Sciences helped to set up a technological line for the production of such machine tools. This contributed to the increase of the standards of production.

Interesting work was performed at the Siberian Department of the USSR Academy of Sciences under the supervision of Academician V.Ye. Panin. He proposed a new method of obtaining materials. Its essence reduces to the following: the shear and rotational waves, which originate during deformation, form a rotor and make it possible to create a strengthened structure of the material. The cutting parts of various tools, which have been made of this material, have a high load capacity.

A joint meeting of the Problems of Machine Building, Mechanics, and Control Processes Department and the Physical Chemistry and Technology of Inorganic Materials Department was recently held. Academicians I.N. Fridlyander, N.P. Lyakishev, V.Ye. Panin, V.I. Trefilov, and M.M. Shults and Corresponding Members of the USSR Academy of Sciences F.G. Reshetnikov and Yu.I. Krasnoshchekov reported on promising developments in the field of material science. I would like to dwell on several of them.

The use in materials technology of the superplasticity effect, which was discovered by Academician A.A. Bochvar, is making it possible to reduce power consumption to one-fifth to one-fourth, to relieve the residual stress, to increase the fatigue strength, and, hence, in the end to increase the life and reliability of machines. This work is being successfully developed at the academic institute that was recently established in Ufa.

Corresponding Member of the USSR Academy of Sciences S.S. Grigoryan with colleagues developed a polymer mineral composite—polymin. It has the stable property of high swelling (by fiftyfold). Polymin will help to solve many problems, which are connected with the elimination of the filtration of fluids through porous media and with the waterproofing of underground structures and will ensure the effective extinguishing of fires in mines and oil storage tanks and the shielding and burial of harmful chemical and radioactive waste.

I will also mention new developments in the field of metrology. A series of instruments, which afford the possibility of scientific diagnosis under the conditions of the operation of machines and equipment, moreover, the diagnosis is made with high accuracy, were developed on the basis of laser equipment. Laser metrological systems were developed, in particular, at the Siberian Department of the USSR Academy of Sciences. The question of their extensive duplication through the Nadezhnost mashin Interbranch Scientific Technical Complex has now been raised.

Research in the field of precision metrology and precision mechanics is being successfully conducted at the Lithuanian SSR Academy of Sciences under the supervision of Corresponding Member of the USSR Academy of Sciences K.M. Ragulskis. The instruments developed here are original with respect to the ideas incorporated in them, many countries of the world have purchased licenses for them. These are high-precision manipulators and high-speed ultraprecision systems, which ensure positioning in space to an accuracy of micrometers.

A number of interesting developments on metrology were turned over to the national economy by defense sectors. For example, a jet gravimeter, a stand for precision calibration with a practically absolute (conditionally, of course) vibration isolation system.

The Problems of Machine Building, Mechanics, and Control Processes Department is actively cooperating with the Geology, Geophysics, Geochemistry, and Mining Sciences Department in the use of vibration methods for the crushing of rocks, as well as in the area of the use of wave technology. The study of the dynamics of "machining tool—power source—medium" systems made it possible to develop a number of fundamentally

new tools and devices for the mining industry, including oscillating conveyors, vibrating belts, and vibrational mills.

The Problems of Machine Building, Mechanics, and Control Processes Department is doing much work on the problem of the safety of nuclear power plants. It is very important to detect the initial appearance of cracks in nuclear reactors. Many works have been written on this theme, while in recent times diagnostic aids and methods of studying not only abnormal dynamic processes, pressure fluctuations, and irregularities of the operating conditions, but also failures of the joint connector and the appearance of initial cracks have been proposed.

These diagnostic aids make it possible to extend the operation of steam turbines. Quite simple sensors, which are installed on the rotor of the steam turbine, establish the likelihood of the appearance of defects. After detecting a defect, it is possible, without halting the operation of the heat plant for a long time, to immediately stop the rotor, to remove the part of metal with the defect, and to resume the use of the rotor.

Nuclear power engineering and several other sectors of the national economy need an increased reliability of piping systems that are subject to high dynamic loads. It is proposed to make pipelines out of a new material—metallolastic. It has a structure that is reminiscent of a sandwich: thin sheets of metal alternate with just as thin layers of rubber. Pipelines made of metallolastic dampen any dynamic loads and vibrations and damp self-oscillating phenomena that originate in flows of a fluid.

I will proceed to the problems of transportation. The commission for transportation, which is headed by Academician Ye.A. Fedosov, has been working at the USSR Academy of Sciences about 2 years. It is actively promoting the development of promising transportation systems, including a high-speed locomotive. The development of a railroad car on a magnetic cushion is continuing. A number of problems of linear mechanics, stability, and control have to be solved.

In the opening remarks G.I. Marchuk spoke about the major achievements in the area of the development of a cargo transport airplane of the AN series. In its technical parameters this airplane surpasses all those known in the world. However, for the present it is not being fully exploited. Economists should develop the optimum system of the use of this unique structure.

The problem of an ecologically clean engine for the motor vehicle is extremely urgent. Such an engine has been developed in practice, but industry, unfortunately, is changing over very slowly to its production.

Ecologically clean and economically profitable air transport—the Tu-155 airplane—which runs on liquid hydrogen or liquified natural gas, has also been developed. This airplane is paving the way for cryogenic aircraft. However, there are many unresolved questions here—questions of control, refueling, and safety.

A few words about the Buran space transport system. Many leading scientific centers, laboratories, and institutes of our country took part in its development. In the process of the work an extensive set of studies was completed and new materials, technologies, and diagnostic aids were developed. They will find use in medicine, biology, and a number of other scientific directions. This will be a real result of the conversion of defense sectors of industry.

Academicians A.N. Tikhonov and A.A. Samarskiy performed much work in the area of software for the Buran transport system. A number of original solutions, which may also find use in civilian machine building, were obtained. Previously due to certain restrictions we could not transfer these programs to the sectors of the national economy. Now this has been done.

I want to note that the Academy of Sciences in recent times has taken a number of major steps for the development of the technical sciences. An agreement on cooperation with the Japanese Association for the Development of Scientific Ties With the USSR was signed. The program of cooperation will encompass the problems of new materials and the safety of nuclear power plants. The Academy of Sciences is performing a number of interesting joint operations with the American Society of Mechanical Engineers, the U.S. National Academy of Engineering, and the U.S. National Academy of Sciences. Talks were held with the Swedish Royal Engineering Academy of Sciences on cooperation in the field of materials science and diagnostic systems for the assurance of the safety of atomic engineering.

In connection with the tragic events in Armenia many reproaches are now being addressed to the Academy of Sciences and to some degree to specialists in mechanics of the Problems of Machine Building, Mechanics, and Control Processes Department. I want to emphasize that our norms and approaches to earthquakeproof construction conform to the international ones. But the shortcomings of the technology of materials, their low quality, and deviations in construction led to such regrettable consequences. The department has now stepped up work in the area of seismic stability and materials science.

The Academy of Sciences is slowly developing research in accordance with the Progress-95 Program, which was formulated for the Moscow Region. This program is actually subordinate to one goal—the ecological cleanness of Moscow and its industrial enterprises. A number of academic institutes are performing successful work within the program. For example, the Institute of Organic Chemistry imeni N.D. Zelinskiy of the USSR Academy of Sciences proposed ecologically harmless chemical reagents for the elimination and prevention of snow and ice formations, the Institute of Elementoorganic Compounds imeni A.N. Nesmeyanov of the USSR

Academy of Sciences tested new antifriction materials. We need to step up the work.

In conclusion I will recall the Machine Reliability Program, in which nearly all the academy departments, including the Ural and Siberian departments, are taking an active part. It is necessary for the Far Eastern Department of the USSR Academy of Sciences also to join in the work on this program.

Vice President Nefedov Report

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[Text] The importance of chemistry in modern society is very great for the development of all sectors of the national economy. However, thus far it has not taken its proper place in our country . In the USSR the share of chemical products is less than 7 percent, while in other industrially developed countries it comes to 10 to 15 percent. Approximately a third of the equipment of our chemical plants does not conform to the present level.

Unfortunately, the state of affairs in the chemical sectors of industry for the most part correlates with the status of chemical science in our country, which for a long time was in the position of Cinderella. The situation with the supply of research with foreign currency, instruments, equipment, reagents, and materials is quite deplorable. It should also be regrettably stated that among the 18 academywide programs on basic research a place was not found for a program on general questions of chemistry.

Let us examine a number of specific results that were obtained in this field of knowledge. The successful development of research on radiospectroscopic methods and spin chemistry, which has traditionally been conducted at a high level at the institutes of chemical physics and chemical kinetics and combustion of the Siberian Department of the USSR Academy of Sciences, should be noted. Electron paramagnetic resonance of high space-time and frequency resolution, which makes it possible to study chemical processes on a nanosecond scale, was developed. The corresponding equipment was developed in advance of similar work abroad.

The discovery of the magnetic isotope effect with the involvement of the silicon atom (in addition to the previously known carbon and oxygen) is an important result. This is research of the Institute of Chemical Physics imeni N.N. Semenov. The indicated effect appears in the isotope enrichment of the source organosilicon compound.

A new method of the nuclear magnetic resonance tomography of solid specimens, which makes it possible to determine the internal stresses in a solid, which is of great importance for the development of nondestructive methods of testing, was developed.

At the Institute of Elementoorganic Compounds imeni A.N. Nesmeyanov a new interesting structural dynamics phenomenon, which is called redox-rotation and consists in the intramolecular conformational rearrangement of the ligand of the metalloorganic compound with the reversible change of the valence of the transition metal atom which is coordinated with it, was discovered.

In the area of the study of the mechanisms of organic reactions and the basic types of their intermediates one should note the work of the Novosibirsk and Moscow institutes of organic chemistry on the obtaining of new types of aromatic pi-complexes with a cation of nitrosonium and long-lived sigma-complexes, which have been stabilized by an anion of trichlorgerman, as a new superacid. Interesting results were obtained on the chemistry of free radicals, carbenes, and their complexes.

In the section of synthetic organic and elementoorganic chemistry some stepping up of the research on the development and synthetic use of new reagents and advanced methods of the activation of reacting molecules, on the use of metallocomplex and interphase catalysis, and on the directed multistage synthesis of low-molecular bioregulators took place during the period under review. Nevertheless, it is important to intensify the work in this important direction, which determines the level of domestic small-tonnage chemistry. The studies of new approaches to the planning and forecasting of organic synthesis with the aid of computer methods also require serious support.

The development of new materials is a most important section of chemistry today; the basic scientific developments in a number of these directions are at a quite high level and often are not inferior to foreign developments. At the same time the degree of their readiness for practical assimilation and the pace and scale of introduction are appreciably less than in industrially developed countries. Here the most substantial lag is being observed with respect to ceramic and composite materials. Suffice it to say that the share of nonmetallic materials in the total amount of construction materials in our country comes to 1-2 percent, whereas in the United States it comes to 15-20 percent, while in Japan by 2000 it is expected to be at the level of 50 percent.

The gains, which were made in this direction during the past year, are connected with the development of a large series of diverse new construction materials with extremely high characteristics for the Energiya-Buran space rocket system. A new approach to the development of welded metal components and structural steels for

them with a set anisotropic structure and unique properties was implemented for the first time in world practice (the Institute of Electric Welding imeni Ye.O. Paton and the Institute of Casting Problems of the Ukrainian SSR Academy of Sciences). The basic laws of the formation of the crystalline structure of slab ingots of directional solidification were established for the first time, which made it possible to develop and introduce at the Mariupol Heavy Machine Building Plant a technology of producing defect-free slabs of large thicknesses.

The physical chemical principles of the development of fundamentally new alloys with an amorphous structure on the basis of intermetallic systems with bulk amorphization in items, which surpass by five-to-tenfold the best specimens produced in the United States, Japan, and the FRG, were formulated, which is making it possible to ensure a high level of the service properties of parts of instruments and components.

On the basis of basic research in the area of the thermodynamics and the kinetics of the interaction of low-temperature plasma with matter new design versions of plasma metallurgical units of increased efficiency were proposed, and the design of a continuous multiple-arc plasma reactor for the reduction smelting of oxides was also developed. The developments conform to the world level and do not have analogs.

A technology of obtaining an aluminum alloy with lithium of reduced density for the production of crucial elements of aircraft with the use of welding was developed and introduced in series production.

A method of the uniform high-speed electrochemical machining of various inorganic materials (metallic, ceramic, semiconductor), which makes it possible to obtain finished items of any complex form from materials that are hard to machine, was developed for the first time in domestic practice (the Institute of Chemistry of the Ural Department of the USSR Academy of Sciences, the Kirov Electrical Machine Building Association of the Ministry of the Aviation Industry). The development of a new class of materials—optical porous glasses for solid-state liquid lasers—has already been spoken about here. Optical porous glasses for holography were also developed. New easily decontaminated organosilicate coatings were assimilated in pilot industrial production and were used at a number of facilities, including during the construction of a nuclear icebreaker and during repair operations in Chernobyl (the Institute of Silicate Chemistry imeni I.V. Grebenshchikov of the USSR Academy of Sciences). Two-layer fiber lightguides with a core and sheath based on an arsenic-sulfur system with small optical losses, which surpass the best foreign fibers of the same compositions, were developed (the Institute of Chemistry of Ultrapure Substances of the USSR Academy of Sciences, the Institute of General Physics of the USSR Academy of Sciences). Fundamentally new filters based on ultrapure silicon dioxide, which surpass the foreign Nucleopore filters and domestic nuclear filters, were developed (the Institute of Chemistry of Ultrapure Substances of the USSR Academy of Sciences).

The physical chemical principles of the complete processing of Kola nephelines with the obtaining of alumina, soda products, and amorphous silica were developed. The process is undergoing pilot industrial testing and is of great importance in connection with the need to solve the problems of the more complete use of our raw material resources.

Today no other direction of research, in which inorganic chemists and physical chemists are participating, is receiving such vigorous material support as the development of materials for high-temperature superconductivity (VTSP).

Last year alone 35 million Soviet rubles and nearly 6 million foreign currency rubles were allocated to chemists for this work. This year these figures come respectively to 40 million and 9 million rubles. And although the distribution of these assets is taking place on a competitive basis, there is no complete certainty of their correct and most efficient use. In particular, one should treat with great understanding the projects of institutes of the General and Technical Chemistry Department on the obtaining of polymer composites with the formation of the needed ceramic in the medium of a polymer binder and on the directed use of elementoorganic polymers for obtaining high-temperature superconducting materials.

Of the most interesting chemical results on the problem of high-temperature superconductivity one should note the obtaining of a fundamentally new class of superconducting indium and potassium cuprates with a temperature of superconductivity of about 100 Kelvin and the development of methods of obtaining a number of new high-temperature superconductors based on complex oxides of thallium, bismuth, calcium, barium, strontium, and copper with a temperature of transition to a superconducting state of 86-152 Kelvin. The closer cooperation of chemists with physicists both at the stage of the planning of research and at the stage of the evaluation of the intermediate and end results is needed here.

An important role in the development of new nonmetallic materials belongs to polymer chemistry. The potential of our knowledge about polymers is quite high, but in a number of most important directions of technical polymer chemistry a chronic lag continues, especially in the area of the produced assortment of polymers and the volumes of their production. First of all this pertains to construction plastics, polymers, and polymer fibers with preset functional properties. Major unsolved problems exist in our country in the area of composites, which are intended for work under high loads. The most important direction on the formulation of the scientific principles of the development of a number of important mixtures and alloys of polymers is at a low level. Unfortunately, as

before the development at a leading pace of the production of metal, not polymer, construction materials is also envisaged for the immediate future. And although the main cause of the formed adverse situation lies in the production technology sphere, many unsolved problems also exist in the area of scientific research and development.

It should be noted that during the year under review definite positive changes occurred in the development of composites with binders on the basis of construction thermosoftening plastics. The synthesis of completely aromatic polyimide binders, which are promising for the development of carbon fiber reinforced plastics, was spoken about in the speech of G.I. Marchuk. However, the front of the operations on carbon polymer materials, especially at the Academy of Sciences, is inadequate, and it is necessary to intensify them. One should note with satisfaction the initiative of the Siberian Department, where the organization of the Institute of Chemistry of Carbon Materials is envisaged within the Kemerovo Scientific Center which is being established. The work on liquid crystal polymers, which are opening the way to the development of a new generation of superplastics and thermoplastic binders for composites, is interesting and important. This work is being successfully developed at the Institute of Petrochemical Synthesis imeni A.V. Topchiyev of the USSR Academy of Sciences, the Institute of High Molecular Compounds, and a number of others. However, its pace and amounts for the present are inadequate. Work on the development of organic polymer materials with unusual electrical properties is being successfully developed at the Institute of Chemical Physics, the Institute of Elementoorganic Compounds, and a number of others. This work is aimed at the development of promising voltaic cells, storage batteries, molecular capacitors, electrochrome devices, and new equipment.

The development of polymer membranes for various purposes is one of the important directions of polymer chemistry. In particular, new types of high-performance membranes for various processes of gas separation in petrochemistry, the chemistry of petroleum and gas, biotechnology, and other fields of technology were obtained at the Institute of Petrochemical Synthesis. Membrane methods and processes are of great importance for the solution of various ecological problems. Great hopes in this respect are connected with our participation in the activity of the Membrany Interbranch Scientific Technical Complex and with the establishment in Vladimir of a center and department of membranes and membrane processes. Here one should also note the quite successful participation of the Institute of Elementoorganic Compounds and the Institute of Electrochemistry imeni A.N. Frumkin in the devising and development of a technology for obtaining polyfluorinated membranes for chlorine alkaline electrolysis. This is of serious ecological importance.

Catalysis is an important section of modern chemical science and technology. Many institutes and scientific councils and the Katalizator Interbranch Scientific Technical Complex traditionally participated in the work in this direction. This research is connected with such important fields as petroleum refining, petrochemistry, and coal chemistry, the obtaining of alternative ecologically clean motor fuels and additives to them, including ones of a nonhydrocarbon nature; the chemistry of monocarbon molecules, first of all the development of synthetic methods on the basis of methane, CO, and CO_2; the optimization and the increase of the productivity and efficiency of chemical processes and works; the neutralization and reclamation of harmful discharges of chemical and metallurgical works, thermal electric power plants, and motor transport; the development of low-waste and waste-free technologies. The importance of these directions is well known.

I will dwell on several specific results. As examples it is possible to mention the obtaining of active and stable selective catalysts of the oxidation conversion of methane into hydrocarbons of CO_2 composition and formaldehyde and the development of a number of new catalysts, which do not contain or contain the minimum amount of precious metals, for removing CO, CO_2, nitrogen oxides, and other harmful impurities from process gases; selective catalysts for the processes of dehydration, alkylation, and hydroformylation, the synthesis of new complexes of zero-valent iron, which are capable of reacting with molecular nitrogen and hydrogen.

The development at the Institute of Catalysis of the Siberian Department of the USSR Academy of Sciences of catalytic processes under nonstationary conditions, which are being used successfully for the protection of the atmosphere against toxic emissions, is of great scientific and practical (first of all ecological) importance. Great hopes for the broadening of the front of work on catalysis are connected with the Katalizator Interbranch Scientific Technical Complex. However, the weakness of the pilot and industrial base of this complex, just as of many other chemical institutes, and the lack of settlement of questions of financing are checking substantially the progress of development.

The establishment in the Saratov Region of the Department of Chemistry of Natural Gas and the establishment of the Institute of Coal Chemistry and Underground Gasification within the Kemerovo Scientific Center of the Siberian Department, which is being organized, are specific steps on the intensification of our research in the field of the chemistry of coal, petroleum, and gas. The expansion of the work on the chemistry of natural and casing-head gas at the Institute of Petroleum Chemistry in Tomsk and the research in the area of membrane methods of gas separation at the Institute of Petrochemical Synthesis also belong here.

The problem of chemical heat sources is also connected with the solution of important power engineering and ecological problems. The development at the Institute of Electrochemistry of the Ural Department of the USSR

Academy of Sciences of new materials for highly efficient solid electrolytes and electrodes, which are necessary when developing high-temperature electrochemical devices, is a substantial achievement in this direction. Such elements, which have been obtained without the use of precious metals, makes it possible to convert the chemical energy of hydrogen, natural gas, and other gaseous fuel into electric power with an efficiency of up to 60 percent. Autonomous electric power generators with a rating from 1 kilowatt to several megawatts can be developed on their basis.

In speaking about the necessity of the sharp reduction of the harmful effect of various chemical works and power plants on man and the environment, the importance of the work of our institutes on energy and resource conservation, on the chemistry of ecologically safe energy carriers, and on the development of new, more efficient, and safe technologies should be emphasized. In particular, it is necessary to increase the attention to and the support on the part of the Presidium of the USSR Academy of Sciences and the General and Technical Chemistry Department of the work, which is being performed under the supervision of Academician N.S. Yenikolopov at the Institute of Synthetic Polymer Materials, on solid-phase chemical reactions as the basis of the development of ecologically clean technological processes in chemistry, the pulp and paper and textile industries, and nonferrous metallurgy, as well as the work of the Termosintez Interbranch Scientific Technical Complex on the further development and practical use of self-propagating high-temperature synthesis processes. The problem of the chemistry of hydrogen—both as an ecologically clean energy carrier and as an important chemical reagent—also holds an important place here.

In connection with the research on electrochemistry one should also note the theoretical and experimental checking, which was begun on a crash basis at a number of chemical and electrochemical laboratories, of the recent report, which caused a sensation, on so-called low-temperature thermonuclear fusion.

As is known, important scientific directions of our chemical institutes are connected with the accomplishment of the Food Program, of which the development of new chemical means of protecting plants and animals is one of the aspects. The research in this field for the most part was aimed at the development of a technology of obtaining highly effective, ecologically safe preparations with small rates of consumption and fast biodegradation. Research is being conducted on a broad front on the development and practical use of pheromones, juvenoids, chemosterilants, and other preparations of hormonal action, the application of which will make it possible to decrease sharply the scale of use of pesticides and to reduce the chemical load on soils and biocenoses.

Another aspect of the participation of chemists in in the solution of the food problem is connected with the so-called chemistry of food. It is well known that the degree of use of agricultural products in our country is intolerably low. Therefore, the changeover to new methods of their processing will make it possible not only to increase substantially the balance of produced foodstuffs with respect to the necessary useful components, but also to obtain, for example, up to an additional 1 million tons of food proteins, which is equivalent to 5 million tons of high-quality meat and meat items. The work on the reclamation of the collagen-containing waste products of leather production promises serious prospects and a large economic impact. Not only the intensification of this work, which for the most part is being performed at the Institute of Elementoorganic Compounds, but also the establishment of the specialized Institute of Chemistry of Nutritive Substances are one of the priority tasks here.

The participation of scientists of the chemistry departments and institutes in the evaluation of major national economic projects also seems extremely important and crucial. The supply of the necessary instruments and analytical methods is of enormous importance for the solution of ecological problems. Work on the development of a new generation of analytical equipment, particularly chemical sensors for the determination of gases and ions of metals in solutions, as well as in the area of flow injection analysis as one of the most effective and economical approaches to the automation of the methods of determining the chemical composition of liquid media and the express analytical monitoring of technological processes was actively performed at chemical institutes. Nitrate-selective sensors and the corresponding instruments for the approximate analysis of agricultural products, sewage, and fresh waters for nitrates were developed. This is the work of the Institute of General and Inorganic Chemistry imeni N.S. Kurnakov.

In speaking about such important problems as the support of young scientists and the integration of the efforts of the union academy and the republic academies, it is necessary to talk about the useful meeting with the chairmen of the councils of young scientists of chemical institutes in connection with the preparation of proposals on the fund of young scientists and about the conferences held by us of the academician secretaries of the chemistry departments of the USSR Academy of Sciences and the republic academies on the formulation of a common strategy.

In conclusion a few words about the chronic and even progressive disease of our academy. This is the question of the optimization of the structure of academic scientific institutions and its central staff. Its goal is the increase of the degree of support and service, in the good sense of this work, of basic science and scientists of all ranks. Not only the reserves of the increase of their output are connected with this. Questions of prestige are also here. Numerous meetings with colleagues show that the level and forms of such supply of science and scientific personnel and their support often not only are not increasing, but are even deteriorating drastically. In

particular, the directors of many institutes and many members of our department are criticizing the so-called decentralization of the registration of foreign business trips. It reduced in essence to the fact that all the concerns and all the troubles (and there are very many of them) were shifted onto the shoulders of the scientific associates themselves, who have to perform functions that are not characteristic of them. These and similar problems, in my opinion, merit the most serious discussion and, obviously, not only in the Presidium of the academy, but also at our general assemblies. For it is necessary, of course, to begin the formation of the good material, moral, and social support of basic science and its creators with the academy itself.

Vice President Petrov Report

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[Speech by Vice President of the USSR Academy of Sciences Academician R. V. Petrov at the Annual General Assembly of the USSR Academy of Sciences on 11 April 1989 under the rubric "The Annual General Assembly of the USSR Academy of Sciences": "The Report of Vice President of the USSR Academy of Sciences Academician R. V. Petrov"]

[Text] In all, 39 academicians and 79 corresponding members work in the 3 biology departments of the USSR Academy of Sciences (the General Biology Department, the Physiology Department, and the Biochemistry, Biophysics, and Chemistry of Physiologically Active Compounds Department). A total of 35 institutes and 26 institutions of the territorial departments of the Academy of Sciences operate under the supervision of the 3 departments.

It is necessary to emphasize that biological knowledge—I have in mind both experimental development and theoretical generalizations—is being accumulated not only at institutions of the biology departments, but also at a number of institutes of departments of the chemical and physical mathematical type, at institutes of the departments of earth sciences and so on. Academician G.I. Marchuk has already spoken about lasers in medicine. The developments of Academicians N.A. Plate, V.A. Kabanov, and others with respect to the problem "Polymers in Medicine and Biology" are also well known.

In my report I would like to list the most important achievements of last year for each department or for each institute. However, in connection with the time limit I will confine myself to just those which emerged in all-union or global programs.

In the Physiology Department the study of the property of the neurons of the subcortical formations of the human brain to take part in thought activity was completed (Academician N.P. Bekhtereva). The involvement of the subcortex in thinking is not just a theory. This is affording new prospects for the diagnosis and treatment of nervous and mental diseases. The cortical areas, which are characteristic of different types of intellectual activity, and the mechanisms of plasticity were identified (Academician P.V. Simonov). It was established that a large role in the development of vascular disorders in the presence of stresses belongs to norepinephrine, which affects the tonicity of vessels in the lowest concentrations (Academician V.A. Govyrin). The mechanisms of the modulation of the function of the ion ducts of cells by neurohormones were determined (Academician P.G. Kostyuk). The increase of the noise immunity of the auditory system of man in case of the detection of a moving source of sound as compared with an immobile source was shown (A.Ya. Altman, the Institute of Physiology imeni I.P. Pavlov of the USSR Academy of Sciences). New data were obtained with respect to the study of the physiological peculiarities of the human body during space flights (Academician O.G. Gazenko).

As a whole, the work on human physiology acquired great importance. This made it possible to substantiate and include among the 18 priority programs of the Presidium of the USSR Academy of Sciences the program "The Support of the Vital Activity of Man in the Processes of Labor Activity on the Basis of the Discovery of Basic Physiological Laws."

Many scientists of the Physiology Department for a number of years were supporters of the establishment in the country of the Institute of Man. They actively substantiated its necessity, the group of tasks, and the sociological significance of such an institute. The year 1988 was the Rubicon: both scientific and public opinion at last came out resolutely in favor of such an institute. As you know, according to the report of Academician I.T. Frolov the Presidium of the USSR Academy of Sciences has made the decision on the establishment in Moscow of the Institute of Man of the USSR Academy of Sciences. Important work on its organization is in store for all of us.

The Biochemistry, Biophysics, and Chemistry of Physiologically Active Compounds Department is the ideological and methods center of the work, which is being performed in our country in the field of molecular and physical chemical biology and biotechnology, including research on genetic, protein, and cell engineering, and in recent times also on the genetic engineering of higher organisms—plants and animals. I will dwell on three sets of achievements, which in 1988 significantly raised our scientific and organizational level not only within our own country, but also on an international scale.

The first set of achievements concerns the deciphering of the primary structure of the genes of a number of microorganisms, plants and animals, and man, the cloning of genes, as well the deciphering of the complete genomes of several viruses. The structure of more than

30 genes and genomes was determined at institutes of the department, as well as at other scientific institutions. Thus, the genomes, that is, the entire hereditary apparatus, of the viruses of hepatitis type A and tick-borne encephalitis and several phytopathogenic viruses were completely deciphered. This is the work of the Institute of Molecular Biology imeni V.A. Engelgardt of the USSR Academy of Sciences, the Institute of Bioorganic Chemistry imeni M.M. Shemyakin of the USSR Academy of Sciences, and the Novosibirsk Institute of Bioorganic Chemistry of the Siberian Department of the USSR Academy of Sciences, Moscow State University, and the Vektor Scientific Production Association (Academicians A.A. Bayev, V.T. Ivanov, D.G. Knorre, and A.D. Mirzabekov, Corresponding Members of the USSR Academy of Sciences I.G. Atabekov, L.S. Sandakhchiyev, and others). The structure of the genes of the proteins of cow's milk, the reserve proteins of wheat and oats, and a group of genes of rye and barley, which codes the proteins of photosynthesizing system II, was deciphered by researchers of the Institute of General Genetics imeni N.I. Vavilov of the USSR Academy of Sciences and the Institute of Bioorganic Chemistry imeni M.M. Shemyakin of the USSR Academy of Sciences (the collectives of Corresponding Member of the USSR Academy of Sciences S.V. Shestakov, Ye.V. Ananyev, and S.N. Gorodetskiy). The primary structure of the group of genes, which support the functioning of the adenosine triphosphatase system in bacteria, animals, and man was determined (the Institute of Bioorganic Chemistry imeni M.M. Shemyakin, the collectives of Corresponding Member of the USSR Academy of Sciences Ye.D. Sverdlov and N.N. Modyanov). The genes of neuroleukin and metastasin were deciphered at the Institute of Molecular Biology imeni V.A. Engelgardt. The last gene was recently discovered: it correlates with the capacity of cancer cells for metastasization and with the ability of tumors to metastasize (Academician G.P. Georgiyev).

I will confine myself to these examples. I will stress merely the scale and amounts of such research. The deciphered gene of adenosine triphosphatase proteinase consists of about 2,400 pair of nucleotides. The neurospecific gene of the fruit fly, 3 copies of which are contained in the genome of man, consists of 7,200 pair of bases. The deciphered complete genome of the virus of tick-borne encephalitis consists of 10,485 pair of nucleotides.

I am insistently listing all this in order to illustrate the indisputable fact of the accumulation in the country of a significant potential in decipherings of the primary structure of genes and genomes. It provided grounds to raise the question of establishing the all-union program "The Human Genome." Last year it was approved. The debates at the assemblies of the department, at the meeting of the Presidium of the USSR Academy of Sciences, and in the press made it possible to optimize the program and to envisage in it the quickest deciphering of the most significant sections of the genome with the study of the biosynthetic mechanisms of the realization of the gene-feature information.

The program has begun its life. The coordinating council, which is headed by Academician A.A. Bayev, has begun the competitive selection of themes. The council became a part of the International Human Genome Organization and participated in the writing of its declaration in Valencia. In June of this year the council will hold a conference in Moscow. Judging from the responses in the press, the program is having international repercussions.

The second set of achievements, which made it possible to substantiate, formulate, and approve among state programs a completely new original project, concerns the cell-free synthesis of protein. This entirely priority Soviet development is connected with the name of Academician A.S. Spirin. In addition to the Institute of Protein of the USSR Academy of Sciences the Institute of Biochemistry imeni A.N. Bakh of the USSR Academy of Sciences, the Institute of Molecular Biology imeni V.A. Engelgardt of the USSR Academy of Sciences, and a number of other institutions are participating in the work. The developed cell-free continuous system of translation is yielding newer and newer data and opportunities. In 1988 the cell-free synthesis of globin with a yield of 250 micrograms per milliliter was accomplished—this is an enormous yield. The development of the synthesis of the proteins of the virus that is the pathogen of AIDS was begun. It should be stressed that the proteins and peptides, which have been synthesized under cell-free conditions, are not contaminated by other proteins or peptides. A pure product is obtained at once.

The Presidium of the USSR Academy of Sciences, having heard in early 1988 the report of Academician A.S. Spirin, supported the idea of establishing a special all-union project, which after a number of bureaucratic difficulties was adopted as an independent, specially financed section of the state program on the latest methods of bioengineering. It originated itself as a consequence of the successes of biotechnology and is actually a part of it, which conforms to the most advanced stage of development. In short, bioengineering as compared with biotechnology as if emphasizes the higher level of technology with regard to qualification.

To illustrate the results, which were achieved in 1988 and made it possible to formulate and adopt the state program on bioengineering, I will cite a few examples from the area of protein engineering and from the area of the development of transgenic plants and animals, that is, higher organisms that bear functioning genes of other organisms. In these cases it is actually a matter of the development of plants and animals, which previously did not exist in nature.

At the Estonian Biological Center of the Estonian SSR Academy of Sciences a bacterial expression of hybrid protein in the form of a single macromolecule, which consists of the human protein cancer p53 and the protein of the frog, was obtained by the methods of genetic protein engineering. This is an extremely promising

means of seeking cancer vaccines. Transgenic mice, which bear in their genome the human gene of interleukin-2, were developed. This gene works by ensuring a threefold higher content of leukocytes in the blood of these mice. The bulk of the work was performed by associates of the Institute of Chemical Physics imeni N.N. Semenov of the USSR Academy of Sciences. Much work on chemical mutagenesis is being performed at this institute under the supervision of Corresponding Member I.A. Rapoport.

At the Institute of Developmental Biology imeni N.K. Koltsov of the USSR Academy of Sciences the operation of transgenic transport was performed on 500 pig embryos for the transfer of the genes of the growth hormone of a bull and the genes of human hepatitis B virus. Several transgenic piglets, the liver cells of which produce the proteins of the virus, which so are needed for the development of a vaccine against hepatitis, were obtained (the work of B.A. Kuzin jointly with G.N. Yenikolopov from the Institute of Molecular Biology imeni V.A. Engelgardt of the USSR Academy of Sciences and Academician of the All-Union Academy of Agricultural Sciences imeni V.I. Lenin L.K. Ernst).

A group of institutes (the Institute of Molecular Biology imeni V.A. Engelgardt of the USSR Academy of Sciences, Moscow State University, the Institute of Molecular Biology and Genetics of the Ukrainian SSR Academy of Sciences, the Institute of Molecular Biology and Biochemistry of the Kazakh SSR Academy of Sciences, the Institute of Plant Physiology of the USSR Academy of Sciences) developed various technologies of the transformation of plant cells. Cell lines of tomatoes, which are resistant to the antifungal preparation canamycin, were obtained. Transgenic tobacco, which is resistant to X-virus, was obtained. Clover and potatoes, which contain the gene of the reserve protein of legumes—legumin—were obtained. It is necessary to direct particular attention to the last one: the introduction in practice of strains of clover and potatoes, which are highly enriched with respect to the content of protein in them, is creating the prerequisites to escape the problem of the shortage of fodder and food protein. The climatic limitation of the possibility of cultivating soybeans in the USSR and the difficulties with compensating for the protein shortage on the basis of the microbiological industry are well known. In connection with this the bringing of transgenic clover and potatoes, which bear the genes of the reserve protein of legumes, up to practical introduction is an important task of scientists of the USSR Academy of Sciences and the All-Union Academy of Agricultural Sciences imeni V.I. Lenin.

Such is the third set of achievements in the field of biology, which made in possible in 1988 to formulate and approve the state program "The Latest Methods of Bioengineering." Owing to the fifth priority direction of the Comprehensive Program of Scientific and Technical Progress of the CEMA Member Countries, "Biotechnology," this program is also of international importance. Academician A.T. Mokronosov, Corresponding Member of the USSR Academy of Sciences R.G. Butenko, and Corresponding Member of the All-Union Academy of Agricultural Sciences imeni V.I. Lenin K.G. Skryabin made a large contribution to the work on the biotechnology of plants.

In the field of microbiological technology the works of Academicians G.K. Skryabin and M.V. Ivanov, as well as G.A. Zavarzin, V.G. Debabov, and Ye.N. Kondratyeva are well known.

The technique, which was developed by Academician D.G. Knorre, of producing "antisense" oligonucleotides, which owing to complementarity block with precision specific "sense" segments of the genome, is a special type of bioengineering. These segments cease to function. The real prospect of synthesizing specific antiviral and anticancer preparations, including as well preparations against AIDS, is opening up.

It is necessary to say a few words about the work on the problem of diagnosing and treating AIDS. The pathogen of this disease is grouped with RNA retroviruses. After penetrating the cell its hereditary information is read from the viral RNA to the DNA and is incorporated in the gene of the cell. Therefore, the search for drugs against AIDS is the search for agents, which prevent the reading of the information of RNA-DNA or subsequent stages of the building of viral proteins. The Institute of Molecular Biology imeni V.A. Engelgardt of the USSR Academy of Sciences jointly with the Institute of Bioorganic Chemistry imeni M.M. Shemyakin of the USSR Academy of Sciences and the Biogen Interbranch Scientific Technical Complex did not simply replicate the preparation developed abroad—azidothymidine—but developed more advanced technologies and more promising preparations of this type. Their production has been started.

At the USSR Academy of Sciences there are also achievements in the area of the development of means of diagnosing AIDS. An original peptide diagnostic agent, peptoscrin, was developed jointly with the Institute of Immunology of the USSR Ministry of Health and the All-Union Cardiological Scientific Center of the USSR Academy of Medical Sciences. Its production has been started.

In spite of the fact that in my report I have already cited repeatedly work that was performed by institutes of the General Biological Department, it is necessary to dwell separately on several results of the activity of this department, since they are of universal importance.

The all-union priority program of basic research, which was formulated in 1988 in the General Biology Department and is the core of its work, is called "The Optimization of the Use and the Expanded Reproduction of Biological Resources." The supervisor of the program is Academician V.Ye. Sokolov. It was the result of many years of work of institutes, expeditions, and biological

stations on the study of the state, reserves, and distribution of the biological resources of the country. The research was conducted not only on the descriptive, inventory level, but, mainly, from the standpoint of the increase of the productivity of biological resources. But the formulation of the ecological principles of the productivity and reproduction of natural and artificial biological systems and the elaboration of the problems of ecology and environmental protection were and are required for this.

The analytical part of the study of the biological resources of the country was supplemented in 1988 by such works of the Botany Institute imeni V.L. Komarov of the USSR Academy of Sciences as the next volumes of the handbook "Rastitelnyye resursy SSSR" [Plant Resources of the USSR], "Opredelitel lishaynikov SSSR" [A Guide of Lichens of the USSR], and "Sravnitelnaya anatomiya semyan" [A Comparative Anatomy of Seeds].

The Zoology Institute of the USSR Academy of Sciences and the Institute of Evolutionary Morphology and Ecology of Animals imeni A.N. Severtsov of the USSR Academy of Sciences jointly with the academies of sciences of the union republics published the series of monographs "Fauna SSSR" [Fauna of the USSR], "Opredeliteli nasekomykh" [Guides of Insects], and "Krasnaya kniga Armyanskoy SSR" [The Red Book of the Armenian SSR].

The ecological analysis of hydrobionts and fish made it possible to ascertain the crisis of the Barents Sea. A model of the trophic relations of commercial fish of the Barents Sea was developed (the Kola Affiliate of the USSR Academy of Sciences). A master diagram of the distribution of sea algae farms on the Black Sea was compiled (the Institute of Southern Seas of the Ukrainian SSR Academy of Sciences). The Main Botanical Garden of the USSR Academy of Sciences formulated the concept of the formation of a cultigenic area for the economic introduction of natural types of plants. The principle of the biological monitoring of large reservoirs was formulated (the Institute of Ecology of the Volga Basin of the USSR Academy of Sciences, the Zoology Institute of the USSR Academy of Sciences).

Test reagents, which make it possible to determine ultramicroquantities (10 to the minus 12 mole) of harmful substances in the environment, were developed at the Institute of Biophysics of the Siberian Department of the USSR Academy of Sciences. A method of monitoring the early stages of the damage of biocenoses was developed.

A special section of work on the problems of general genetics and selection initially was not envisaged in the priority program on biological resources. By 1988 the situation had formed in such a way that a number of most important sections of classical genetics were outside the zones of influence of financed programs, which previously existed, and, consequently, outside the zones of any decent financing.

On the initiative of Academicians G.P. Georgiyev, M.M. Dubinin, and V.A. Strunnikov, Corresponding Members of the USSR Academy of Sciences S.G. Inge-Vechtomov, I.A. Rapoport, and S.V. Shestakov, and others in the fall of last year we held the All-Union Conference of Geneticists, which was of fundamental importance. At it the issue that our genetics, which had suffered gravely during the years of Lysenkoism, thus far had not healed the wounds of the personnel, material, and moral levels, was raised with new urgency. The USSR Academy of Sciences should direct particular attention to the support of genetics—the basis of all biological disciplines, for biology as a life science is in reality the science of the functioning of genes in cytological, biochemical, and physiological categories.

It is a pleasure for me to report that the Presidium of the Academy of Sciences introduced in the priority program on biological resources a large, separately financed section on general genetics and performed serious work on the preparation of the special government decree "On the Further Development of Genetics." At present the decree has been approved by the necessary departments and is being prepared for issuing.

I would like to say that in addition to genetics we need to strengthen such sections as biochemistry, biophysics, and physiology, without decreasing, of course, the level of research in the field of molecular biology, cytology, microbiology, and biotechnology.

Biochemistry in 1988 made serious gains: new mechanisms of the transport of protons were discovered, new enzymes, proteins, and other biopolymers were deciphered, the cytoskeleton was studied, new medicines and means of their delivery were developed (Academicians A.A. Krasnovskiy, V.A. Kabanov, and N.K. Kochetkov, Corresponding Members of the USSR Academy of Sciences V.L. Kretovich, A.A. Bogdanov, V.P. Skulachev, V.F. Bystrov, R.M. Khomutov, and V.N. Smirnov, and others). In spite of this, the contribution to biochemistry is inadequate, and it should be increased.

Substantial achievements also exist in biophysics: new biosensors were developed, the biophysics of reception and photosynthesis centers and the biophysics of membranes, DNA, and proteins are being studied (Corresponding Members of the USSR Academy of Sciences M.V. Volkenshteyn, I.I. Gitelzon, R.K. Salyayev, and Yu.A. Chizmadzhev, and others). But it is necessary to increase the attention to biophysics. Insufficient forces have been invested in radiobiology, to which the tragic page connected with Chernobyl has been added.

The report would be incomplete, if the organizational problems, which worry researchers, were not added to the indicated shortcomings.

First, the changeover to the new, undoubtedly advanced system of financing requires considerate treatment toward it with very serious coordination both within the academy and between the USSR Academy of Sciences and the State Committee for Science and Technology. The transfer of financing from the State Committee for Science and Technology to the academy or directly to the performing institutes thus far has not been set up, is causing irregularities, is giving rise to the nervousness of the supervisors of programs and the performers, and in many cases is leaving confusion—will it or will it not be, when, and in what amount. Such a situation formed both in case of the implementation of the Cell-Free Protein Synthesis Program and the Human Genome Program and in a number of sections of the fifth priority direction of the Comprehensive Program of Scientific and Technical Progress of the CEMA Member Countries, "Biotechnology." This is destabilizing the process of the competitive and grant distribution of resources.

Second, and this is the basic thing, the task of formulating the main problems of biology for the future is worrying everyone. We have already held several conferences with executives of departments and with leading scientists. I would express a certain integral uneasiness with the following words. In connection with the branched nature of the interests of modern biology there is the fear of the relaxation of attention to its basic, if it can be put this way, trunk problems. During the preceding five-year plan we lived under the slogan "Physical Chemical Biology and Biotechnology." We have to find a means of strengthening this slogan, having supplemented it with what life requires, but without having eroded biology with details.

Vice President Laverov Report

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[Text] In 1988 the scientific institutions of two departments of the academy, which are engaged in the elaboration of problems of geology, geophysics, geochemistry, mining sciences, oceanology, atmospheric physics, and geography, performed important basic research. The results of many successfully completed operations, which advanced our knowledge of the processes that are occurring in all the crusts of earth and its core, were discussed at the general assemblies of these departments. A number of basic studies served as the basis for the devising of fundamentally new technologies of the development of mineral resources. The data on the most important research are cited in the annual report of the USSR Academy of Sciences; therefore, I will not touch upon many scientific directions in the field of the earth sciences, which are being successfully developed in our country, but will dwell only on the problems of seismology and oceanology.

The catastrophic 1988 Spitak earthquake in Armenia, the 1989 Gissar earthquake in Tajikistan, and the aggravation of the seismic situation in Kirghizia, on the Kamchatka Peninsula, and in the northeastern part of our country drew to this problem the attention of not only scientists, but also the party and state leadership of the country, all the Soviet people, and the world community.

A large group of scientists of the USSR Academy of Sciences and a number of ministries and departments analyzed the state of the seismological service in the country and proposed radical steps on its improvement. The analysis showed substantial shortcomings of the seismic zoning maps. In recent years the areas of seismically unsafe territories have increased. In the 1960's it was believed that seismically active regions occupy approximately 20 percent of the territory of the country. These regions were studied rather well by seismologists, seismic zoning maps, which served as standard documents for construction, were compiled for them. However, in connection with the building of structures of increased danger, such as nuclear power plants, tall water dams, and chemical enterprises, the danger of seismic events also increased greatly. But if we take into account that in the large cities, which are located in earthquake zones, the size of the population is growing, the anxiety about their safety, of course, is entirely justified. These circumstances made it incumbent to reevaluate fundamentally the seismic conditions on the entire territory of the country.

There is nothing surprising in the fact that at present the area of the seismically dangerous territory in the country has increased from 20 to 35-40 percent. The point is that the methods, which seismologists are now using, make it possible to identify earthquakes, which occurred in the early, prehistoric period, and in a number of cases so-called safe territories, which border on earthquake faults, were transferred to the category of seismically dangerous territories. Accordingly, this requires not only the revision of the seismic zoning of the country as a whole, but also the solution of a most difficult problem: the establishment of a reliable network of seismic observations and the development of the theoretical basis of the prediction of earthquakes which have a different nature.

Unfortunately, a service of seismic observations thus far does not exist in our country. Only a service of emergency reports on strong earthquakes, which uses the data of 55 seismic stations that belong to the Institute of Earth Physics imeni O.Yu. Shmidt of the USSR Academy of

Sciences and to several republic academies, is in operation. This network within 1-1.5 hours after a major earthquake informs government organs about its site and time, but, of course, does not give any earthquake predictions.

In the country there are more than 300 regional seismic stations, which make observations of individual seismically dangerous regions. They are united in a system of territorial networks and are called upon to ensure the prediction of earthquakes. However, this system does not have modern instruments for the recording of earthquakes, communications channels, and the computer processing of observation data. A geological engineering substantiation of the work on the prediction of earthquakes and seismological engineering research also do not exist. And although individual elements of the system of predicting earthquakes have been developed by Soviet scientists at a quite high level, they all the same do not solve the problem as a whole and do not ensure a systems approach to the prediction of the time, place, and force of an earthquake.

The further development of theory and the radical change of the existing system of seismological observations are necessary for the implementation of such an approach. It has now become obvious that the theoretical and practical tasks of prediction go far beyond the present possibilities of academic science, the organization of a statewide system of seismic observations and prediction, which is closely connected with world data centers, is required. The Academy of Sciences has been made responsible for the development of the theoretical basis of the prediction of earthquakes: the development of the theory of the seismic focus, fundamentally new seismotectonic maps, and a comprehensive approach to the integration of geological, hydrophysical, hydrogeochemical, geophysical, and geological engineering data.

The technical base of domestic seismology—measuring equipment, communications, data processing facilities—is absolutely incomparable to the foreign technical base. At the same time in our country there are a number of developments (at the level of prototypes), which in their technical parameters are not inferior to foreign ones. For example, a deep-sea seismic station, which automatically records seismic vibrations on the floor of oceans, as well as broad-band land-based seismic stations. However, their industrial production thus far has not been organized.

The development of the theory of electric probing and the use of magnetohydrodynamic generators for this purpose are one of the achievements of academic science. In such a seismically dangerous region as Kirghizia data, which served as the basis for the prediction that destructive earthquakes are not expected in Kirghizia in the immediate future, were obtained by the method of electric probing. This made it possible to relieve somewhat the tense situation that had formed in the republic in late March of this year. I also want to note that at the Siberian Department of the USSR Academy of Sciences efficient laser strain meters were devised, the method of the vibratory radiograph inspection of the focus zone was developed, and hydrogeochemical research was begun. All these instruments and methods in essence are individual fragments of the system of earthquake prediction, which can be effective. The lack of such a system is making progress difficult not only in the development of a general theory of earthquakes, but also in the accomplishment of practical tasks.

The analysis of the information, which was obtained prior to the 1988 Spitak earthquake, showed that phenomena, which could have been used for a prediction, had they been brought together in good time, been generalized, and gotten into the dependable hands of specialists, preceded this event. Estimates of the seismic danger and the prediction of an earthquake are possible only on the basis of a thorough study of the dynamics of seismic processes in time and space. But a statewide system of seismological observations and information is necessary for this. It should include the All-Union Information and Forecasting Center and a number of observation networks, such as the network of observations of the hydrodeformation field, prediction testing grounds, and a geological information service of ministries. It is also proposed to include in this system the services of the seismic monitoring of facilities of the Ministry of Power and Electrification, the Ministry of Atomic Power, and others. The establishment of a unified system will require the organization at the USSR Academy of Sciences and at the academies of sciences of the union republics, as well as in a number of ministries and departments of scientific research, which, in our opinion, should be included in the State Scientific and Technical Program, which is intended for the period to 2000.

Within this program it is necessary to develop and organize the series production of digital seismological and forecasting equipment and telecommunications facilities for the prompt gathering and transportation of forecasting information; to establish union, republic, and regional forecasting centers, which are furnished with computer hardware and software for the complete processing of all seismological information. It is necessary to set up the training of highly skilled seismologists and geophysicists, who are forecasters, and to raise to a new level the research on the seismotectonics and geodynamics of the earth's crust. The implementation of this program will require not only the efforts of scientists, but also significant capital investments.

The statewide system of seismological observations and information will be established in stages. At the first stage (1992-1995) it is proposed to organize the All-Union Information and Forecasting Center at the Institute of Earth Physics of the USSR Academy of Sciences, the Scientific Center for Engineering Geology and Engineering Seismology at the Institute of the Lithosphere of the USSR Academy of Sciences, and the Central Seismological Expedition of the Institute of Earth Physics,

which is capable of operating efficiently in emergency situations. Such a situation, in particular, formed in Armenia after the Spitak earthquake.

At the second stage, when hundreds of stations, which have been united in the State System of Seismological Information and Forecasting, will begin to operate, the research on seismology in our country will reach the world level.

In our opinion, the establishment of such a system is possible only on the basis of cooperation of the USSR Academy of Sciences with the ministries of the defense sectors of industry. In our days the conversion of the defense sectors of industry is affording good opportunities for the enlistment of enterprises of these sectors in the solution of the problem of seismological safety. At the same time for the prompt production of modern geophysical equipment it would be advisable to establish a joint experimental venture with foreign firms.

The successfully developing international cooperation of seismology scholars made it possible to develop rapidly in Armenia in December 1988 wide-scale seismological observations. In the time that has passed the international groups, to which seismologists of the United States, France, and Japan belong, have obtained unique material, which is of not only narrow special, but also great social importance. The possibilities of a scientifically substantiated prediction of earthquakes have expanded substantially, the great effectiveness of the international cooperation of scientists in the solution of similar problems was proven. The possibility of the organizational unification of the efforts of scientists of different countries also became realistic. Therefore, in March 1989 the Presidium of the USSR Academy of Sciences adopted a decree on the establishment of the International Institute for the Prediction of Earthquakes and Computer Geophysics in Moscow on the basis of a department of the Institute of Earth Physics of the USSR Academy of Sciences.

As to the achievements in the other fields of the earth sciences, one must note the successful implementation of the interdepartmental program of basis research on the world ocean. At present the experimental base of research work in the ocean has been improved substantially. In 1988 the scientific fleet of the USSR Academy of Sciences was supplemented by new ships—the Akademik Sergey Vavilov and the Akademik Ioffe—which are furnished with equipment that makes it possible to perform a wide range of hydrophysical and acoustic remote studies of the layer of waters and the ocean bed. Soviet oceanologists received equipment such as no country in the world had until recently. For example, the Mir deep-sea manned vehicles, which are capable of studying the ocean bed at the depth of up to 6,000 meters. One such vehicle with a diving depth of up to 7,000 meters was developed in Japan only in 1989. At present Soviet oceanology has the Zvuk-LM towed side-scanning sonar with a diving depth of about 6,000 meters and towed underwater vehicles, which are fitted with cameras, television systems, and other equipment. In 1988 the building of a ship with a displacement of 20,000 tons for deep-sea drilling in the ocean was begun at the Nikolayev shipyard. Its drilling rig will make it possible to drill the ocean bed at a depth of 6,000 meters. The depth of the hole, which has been drilled in the ocean bed, will come to 1,500 meters.

It must be said that in recent years American scientists, by using the method of deep-sea drilling, obtained vast material, which changed our notions about the structure of the ocean bed and contributed to the appearance of new geological hypotheses. I am confidence that the combination of the method of deep-sea drilling with the possibilities of deep-sea vehicles will enable domestic oceanology to make a substantial spurt in the study of the world ocean. The new equipment should be used efficiently; therefore, we should already now formulate carefully a program of the use of new equipment for the accomplishment of basic tasks.

Among the many organizational questions, which were examined last year, the preparation for the 28th session of the International Geological Congress, which will be held in July 1989 in the United States, holds a special place. The responsibility for the preparation for such sessions has been assigned to the USSR Academy of Sciences and the National Committee of Geologists.

The Soviet delegation will be quite representative—about 100 people. A group of young scientists up to the age of 30, which will take part in the work of a number of sections of the congress, will be included in it for the first time. During the session of the congress an exhibition, which covers the achievements of our country in the field of the earth sciences, will be on display. A display devoted to the study of the world ocean will be shown on board the research vessel Akademik Mstislav Keldysh. The Mir deep-sea manned vehicles, by means of which studies of the middle ocean ridge in the Atlantic Ocean were made, are installed precisely on this vessel.

In all 23 collections of reports of Soviet scientists have been prepared for the congress. Each of these collections is devoted to the elaboration of priority problems of the earth sciences.

The reorganization of the work of the departments of the USSR Academy of Sciences and the institutes, which are concerned with the earth sciences, is encountering a large number of difficulties. The extremely unsatisfactory material and technical base of the Moscow institutes, which are studying the problems of seismology, engineering geology, water and mineral resources, geography, and others, is causing much anxiety. As has become known to us, the construction of several new institutional buildings has been eliminated from the plans of construction for the new five-year plan. This must not be allowed, it is necessary to take all steps to implement what has been planned.

The supply of institutes of the natural history type with advanced analytical equipment and computer hardware

remains poor. Unfortunately, scientific instrument making, including the academy's scientific technical association, for the present is incapable of meeting the needs of mineralogists, petrographers, and specialists in the area of geochronology and experimental geology. There is hope that the opportunities, which appeared as a result of the conversion of defense sectors of industry, will make it possible in the near future also to solve the problem of the computerization of the earth sciences.

As was already noted in several reports, the shortcomings of the new system of financing are causing great difficulties in the work of institutes. The changeover to the competitive financing of scientific problems for the present is proceeding, unfortunately, formally. The additional allocations, which were earmarked in accordance with the results of competitions, including for ecological research, thus far have not been received in the republics. In recent times I visited many regions of the country and know that in the Caucasus, Central Asia, Belorussia, and Siberia many institutes have been placed in a most difficult financial position, inasmuch as the USSR State Committee for Science and Technology allocated the additional assets without a wage fund. If prompt steps are not taken, during the second half of this year the problem of financing will become already a socially dangerous one. At a number of institutes a reduction of staffs will be required.

In conclusion I want to stress that at the institutes, which are concerned with the earth sciences, the basic directions of the perestroyka of academic science, which were set forth in a number of statements of the president of the USSR Academy of Sciences and other leading scientists of the country, are finding support.

Vice President Kudryavtsev Report

907A0004H Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 8, Aug 89 pp 17-21—FOR OFFICIAL USE ONLY

[Speech by Vice President of the USSR Academy of Sciences Academician V. N. Kudryavtsev at the Annual General Assembly of the USSR Academy of Sciences on 11 April 1989 under the rubric "The Annual General Assembly of the USSR Academy of Sciences": "The Report of Vice President of the USSR Academy of Sciences Academician V. N. Kudryavtsev"]

[Text] Quite complex processes have been occurring recently in the social sciences. They are due to the fact that society itself is being modernized at an unprecedented pace. The 19th party conference, the session of the USSR Supreme Soviet, which amended the Constitution, and, finally, the new elections had an effect here.

As to the social sciences, they are characterized by very contradictory trends. It is obvious that present realities are coming into conflict with previous notions, which are still widespread in the works of social scientists. It is necessary to interpret in a new way the problems that have arisen—political, national, and economic.

The attention to the changes in the social sciences has grown, although here our lag in this field behind the world level—a lag that, unfortunately, is undoubtedly greater than in any other disciplines—has also become quite clear. The trouble is that it was previously not acknowledged, just as the existence of this world level itself was not acknowledged. It was believed that our social sciences did not have points of contact with western social sciences, consequently, in case of their evaluation there could not be a single criterion. Such a stand hindered and to this day is hindering the understanding of many real problems.

I would like to say that during the past year the obvious aspiration to get away from stereotypes, to gradually reappraise values, and to revise a number of assumptions of a fundamental nature emerged.

About what specifically is it necessary to talk? First, about the repudiation of the administrative command system; in different social sciences it is embodied in different processes. In economics this signifies the changeover to the new economic mechanism; in politics this entails changes of the political system itself and its institutions and the democratization of society; in the social sphere and in spiritual culture this is leading to the recognition of the pluralism of opinions; in the area of, say, national policy it is leading to a new view of the federation and of the relations of the center and the republics. And it signifies also a quite large set of specific conclusions for each social science.

Second, a very important circumstance was added to this—the recognition of the priority of human values, which for decades were trampled in our country by the values of theoretical dogmas. The posing of this question for many social scientists was strange, even agonizing.

The third thing is connected with the changeover to new political thinking. It is important to note that the new political thinking and the rejection of the image of an enemy, which is at the center of this doctrine, are of not only foreign political, but also enormous domestic political importance.

And, finally, the fourth item. It is a matter of the development of a modern model of socialism and the modernization of socialist society itself through its humanization and democratization. These tasks, like the notions of the multidimensionality of society and the existence of different models of it, seem offensive to many social scientists. The reappraisal of values, the necessity of which appeared before our humanities, is very difficult. In the field of philosophy it is being accomplished mainly by the efforts of relatively young people. I would name first of all Academician I.T. Frolov and Corresponding Member of the USSR Academy of Sciences V.S. Stepin, who are exerting great efforts so that such a reorientation would occur more rapidly.

Specifically, the all-union program "Man, Science, Society: Integrated Research" has been formulated, the interdepartmental Center of Man has been established, the organization of an institute for the study of man is planned, and so on.

The Institute of Philosophy succeeded in organizing quite quickly the publication of an entire series of works on domestic philosophical thought of the 19th-20th centuries, including non-Marxist philosophical thought. The works of a number of idealist philosophers, which either were not published in our country at all or were published only in the early 1920's, are being prepared for publication and are already being published. A new philosophy textbook, which in structure will differ radically from previous textbooks, is being written.

Another useful publication—a history of foreign philosophical thought, in which both Marxist and non-Marxist teachings will be included—is being undertaken. It is necessary both for the education of philosophers and for the conducting of scientific research. There cannot be a different approach here.

Modernization is also occurring quite actively in the sphere of economic science. I will note in general outline three basic directions. First, the recognition of the multiplicity of forms of property under socialism. Previously it was considered intolerable and impossible. But now the situation has changed. Academicians L.I. Abalkin, A.M. Rumyantsev, T.S. Khachaturov, A.G. Aganbegyan, N.Ya. Petrakov, S.S. Shatalin, and others are playing a very positive role in the popularization of this principle. Incidentally, the elaborations of specific proposals on the leasing contract, which were sent to the government and party organs, passed mainly through our academic scientific institutions.

The second thing is connected with the relations of the plan and the market. What we could call the making of a fetish out of the plan, when it was all but the only method of managing the economy, is being overcome. A more correct relationship between them is now being developed. Although I believe that the work is just beginning.

And the third thing is what we conditionally call regional cost accounting. In essence it is a matter of the economic independence of union republics, oblasts, krays, cities, and rayons, that is, of the decentralization of the management of the economy and of the entire set of questions that are connected with it.

It is also necessary to note that a new, modern textbook on political economy has been published under the editorship of Corresponding Member of the USSR Academy of Sciences V.A. Medvedev. Our academic scientists are participating in it.

In the new Problems of World Economics and International Relations Department quite a lot was done during nearly a year of its existence. First of all I would name the works of Academicians Ye.M. Primakov and G.A. Arbatov. The scientific models of international relations of a new type, which were developed at their institutes, served as the basis for the practical decisions that were made in our foreign policy. These are models of international relations, international ecological safety, and the very complicated problem of the correlation of human values with national, group, class, and even individual interests. In this connection the department is also analyzing the ethnic and regional conflicts that are occurring in the world.

However, reorientation is taking place significantly worse in other spheres of the social sciences. In the field of art criticism and philology rearguard battles, if it can be put this way, are occurring. The turn to a new understanding of socialist realism and in general of Russian literature of the 19th-20th centuries is taking place slowly. True, the National Center for the History of Russian Literature of the 19th and Early 20th Centuries and the National Center for the Study of National Language Relations have been established. But the practical work—the preparation of monographs, in which the appraisals of writers, poets, and scientists, which do not conform at all to the level of world science, would be revised—has come to a standstill. The solution of many problems is being dragged out.

The same thing is happening in historical science, especially in the history of the Soviet period. Of course, this does not concern everyone. I would like to speak with satisfaction both about the books of Academician A.M. Samson, who patched up in his works many "blank spots" of the period of the Great Patriotic War, and about the works of Academician I.D. Kovalchenko, who was elected academician secretary of the department. These are energetic people. But as a whole the problems are being solved here very slowly.

We understand that in the field of history, as the English say, the truth, the whole truth, and nothing but the truth are needed. Now the truth exists, but for the present it is impossible to say that this is the whole truth. But if we take literature on current affairs, there in general the truth is mixed with fiction. A textbook on history is extremely necessary, but thus far it does not exist. This is hindering instruction and is making scientific work difficult. A general concept of historical processes has not been thought out. This is especially important for our country, because the problems of historical alternatives are arising, but in the scientific sense there is no answer to them. There are only hypotheses.

The reappraisal of values also concerns sociology, psychology, and jurisprudence. An in-depth, open, and truthful analysis of modern society with all its contradictions is necessary. But instead of this in reality there is a lag both in the methods of research and in the accumulation of material.

Last year the stagnation in sociology began to be overcome. The Institute of Sociological Research was reorganized, a new director, Professor V.A. Yadov from Leningrad, was appointed. But, unfortunately, many

problems remain unsolved. This concerns first of all the notions about the real interests of our residents subject to their residence in difference regions and to their age and social attributes and about philosophical views, mass consciousness, and mass processes. I am not talking about national problems, which were not studied at all and thus far do not have a serious base for study. True, applied ethnographic problems were solved quite quickly, and here I would like to note the role of Academician Yu.V. Bromley as a fine professional. But as a whole this is a quite neglected sphere.

The same thing should also be said about social psychology. Within this science they dealt rather well with just one problem—the interrelations of man and equipment. Of course, it is interesting to establish the role of the operator, the psychology of a cosmonaut or submariner, and even the behavior of man during catastrophes. But social psychology as a whole is completely undeveloped.

In this connection I wanted to speak about another two substantial shortcomings. First, here things are bad with forecasting and, second, things are bad with models. In practice there are no models of modern socialism, but, in addition to this, broader models are also needed. Scenarios of world development should exist. But no one is dealing with them, in practice no research is being conducted. Here we lag very noticeably behind other countries.

There is also no analysis of the trends of modern civilization. For many decades an exclusively class approach to the study of society, which in itself is useful, but insufficient, dominated in our country. For it is necessary to look at society not only from the position of socioeconomic formations. In addition to this point of view other views of things are also possible. The civilization approach is characterized precisely by the possibility to see the world as a whole, regardless of the division of society into various systems. We do not have such an analysis of modern civilization. But it, of course, is extremely necessary.

This also concerns forecasts. Quite decent applied research exists. For example, now the Institute of Sociology has analyzed the elections of USSR people's deputies and has predicted quite accurate data even on specific candidates for deputies. But all these are special cases, while forecasts of social development for the present are lacking.

New scientific directions have now emerged and have begun to be developed. First, the comprehensive study of man, which includes both social humanities and natural science disciplines, including genetics, biology, and physiology.

Second, political science. For the present it is in embryo. For the decision-making system is the essence of this science. But at the political level no scientist has been admitted to the decision-making system, this area has not been studied by anyone. Now we have established a center of political science research. But its work is just beginning.

Third, comparative jurisprudence. It is the analysis of world legal systems on the comparative level. And, finally, scientology is being developed quite slowly. This, perhaps, is not a new direction, but it was developed so poorly that it is possible to speak about it as a new one. Now, admittedly, some revival has emerged. The process of modernizing the methods of research is also occurring not as quickly as would be liked. There have been no great changes here. The trouble is that in the social sciences we, unfortunately, were unable to use exact methods, although the material base for this has already been created.

One of the causes of the lag behind world science is the fact that social scientists obtain from documents or statistical data the information, which specialists in the area of the exact sciences have in the natural or artificial environment. Hence arises the question of the sources of information that is extremely necessary for us. What are these sources? These are archives, official statistics, or our own sociological research.

As to archives, thus far they are in many respects inaccessible. Historians are justly outraged by this. The Presidium of the Academy of Sciences is dealing with this question. Moreover, an understanding on the establishment of a department of what is called "moral statistics," which previously did not exist, as well as on a joint laboratory has been reached with the State Committee for Statistics. Thus far there are few results, but all the same a center exists. And the third thing is sociological research proper, which is also being developed poorly for statutory organizational and financial reasons. New methods, which are based on a realistic analysis of things, are being put into practice only in the Economics Department.

The international experience of scientific cooperation is also being mastered too slowly, although some reassuring signs have also appeared here. For example, we received the opportunity to send 25 young sociologists to study for 2 years at universities of the United States of America; 20 people will go to Great Britain, also for a long period. And political scientists are establishing the same kind of ties. All this, undoubtedly, will improve the picture.

Some changes are occurring with respect to the introduction of the recommendations of social scientists, although here, too, we cannot be completely satisfied. The USSR Council of Ministers has begun to invite economics scholars to its meetings for the discussion of a number of questions. All of us were able to watch on television the speech of Academician L.I. Abalkin and other comrades of ours. Moreover, they have also begun to attract social scientists to the commissions of the CPSU Central Committee and to listen to their arguments. The recommendations of scientists played a

useful role in the elimination of the consequences of the earthquake in Armenia, in the elaboration of the national question, and in the discussion of foreign political situations. It is necessary to note in particular the work of the department which Academician Ye.M. Primakov directs.

But thus far we have failed to achieve the evaluation of projects, and this worries many people. The incident with the Volga-Chogray Canal, the evaluation of which was lacking, is well known. From the very start it was clear that its construction affects the fate of a large number of people who live in both this and other regions. In my opinion, situations of this sort are intolerable.

We conducted a small sociological survey at our Institute of State and Law. We asked associates to what extent their proposals, which get to state organs, are taken into account. The responses were broken down as follows: the proposals are taken completely into account—0 percent, a large portion of the proposals are taken into account—10 percent, they are taken into account to a small degree—32 percent, they are not taken into account at all—27 percent. If we use a five-point system, it is possible to say that the state of the matter deserves a "three." But this cannot satisfy us.

And a final thing. The internal conditions at institutions and institutes, as well as the personnel situation as a whole are good. True, the problem of the aging of collectives is gradually arising. About half of the scientific associates are over 55. The reduction of the average age is occurring quite slowly. Young directors have been appointed at approximately two-thirds of the institute. But the rejuvenation of scientific collectives is being hindered by the humanly understandable state of things: it is difficult to force someone to retire. And this is affecting the overall picture.

A few words about the remainder principle. As the remainder principle with respect to science was here, so it remains. Things are bad with computers, we are counting only on the promise of the president of the USSR Academy of Sciences to help social scientists in this respect. As to foreign currency and Soviet money, there is not enough of it—everyone is familiar with the situation, and there is no need to talk about it at the General Assembly.

There is also the following thing. I want to direct the attention of the president of the Academy of Sciences to the fact that the decree of the CPSU Central Committee and the USSR Council of Ministers on the Institute of Sociology to this date remains in the Moscow City Soviet and is not being fulfilled: a new building has not been made available to the institute, although there is a decision of the CPSU Central Committee and the USSR Council of Ministers on this account. The Moscow City Soviet Executive Committee is ignoring it completely.

In conclusion I will say: difficult problems face us, progress is slow. Yet I hope that we will gradually make progress in the accomplishment of our tasks, because the main thing has already occurred—the necessity of such progress has been realized.

Glebov Remarks on High-Temperature Superconductivity

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[Speech by Academician I. A. Glebov at the Annual General Assembly of the USSR Academy of Sciences on 12 April 1989 under the rubric "The Annual General Assembly of the USSR Academy of Sciences"]

[Text] In the annual report of the USSR Academy of Sciences the importance of research in the field of high-temperature superconductivity was noted. Academician Yu.A. Osipyan also spoke about the same thing. The main attention of researchers was focused on materials and technological processes. The characteristics of materials are being improved for the purpose of raising the temperature of the transition to a superconducting state and increasing the current density. High current densities were obtained for films less than a micrometer thick. However, for the present the results in the development of bulk superconducting conductors still remain modest. Nevertheless, it is possible to cool a number of electrical devices not with liquid helium, but with liquid nitrogen, which will radically simplify the design solutions and will sharply reduce the cost of the coolant.

In subsequent operations on high-temperature superconductivity it is important not only to increase the current density, but also to ensure the stabilization of the conductors, which prevents the transition of the latter from a superconducting to a normal state. In addition to thermal stabilization, which is used at the low-temperature level, structural stabilization, which keeps the content of oxygen in the material constant for a long time, will be required here.

At a number of laboratories and pilot works of our country high-temperature materials are being produced on the basis of an yttrium-barium-copper-oxygen ceramic. It is quite natural that, while working on high-temperature superconducting materials, researchers should take into account the area of their practical use, including electrical machine building. The development of industrial-type electrical machines of a fundamentally new design requires many years of intense labor. At the All-Union Scientific Research Institute of Electrical Machine Building (VNIIelektromash), which operates under the scientific methods supervision of the USSR Academy of Sciences, in recent times three types of electrical machines have been developed. These are some of the first models in world practice, in which the phenomenon of high-temperature superconductivity is used.

The first type of machine is an induction motor. It has a fixed copper cylindrical three-phase winding which generates a rotating magnetic field. The rotor is a fiber glass cylinder, within which there is a second cylinder made of yttrium-barium-copper-oxygen ceramic. The inside of the cylinder is filled with liquid nitrogen. In connection with the superconducting state of the ceramic cylinder it operates with zero slipping, owing to which a fundamentally new type of synchronous motor without an external power supply of the winding of the rotor is obtained. In ordinary synchronous motors the winding of the rotor is fed from an external power source through a brush contact or from a brushless exciter.

The second type is an electrical machine with excitation from permanent magnets. In it there are two rotating disks. On one, which is caused to rotate by an external motor, permanent magnets are installed, on the other there are hollow cylinders made of yttrium-barium ceramic. In case of the filling of the ring channel of the second disk with liquid nitrogen the ceramic cylinders switch to a superconducting state. A current, the interaction of which with the permanent magnets creates a torque, as a result of which the second disk rotates with a synchronous speed, is induced in the cylinders. Such a machine can be used as an electromagnetic clutch without a mechanical connection between its disks.

The third type of machine is a topological generator, or, as it is often called, a magnetic flux pump. Its armature is produced in the form of a hollow cylinder made of a high-temperature superconducting ceramic. The field coils create on the surface of the cylinder a unipolar magnetic field, which is concentrated by means of rotating terminals. Owing to such a design the local penetration of the magnetic field into the layer of the cylindrical superconductor and the formation of an electromotive force between the ends of the cylinder are attained. The new machine showed the untenability of the theory, which is generally accepted in the world and in conformity with which the local failure of superconductivity is necessary for the operation of a magnetic flux pump. The topological generator makes it possible to abandon bus ducts to large superconducting magnetic systems.

All three types of electrical machines have undergone tests. The appearance in production prototypes requires the development of high-temperature superconducting materials with sufficiently high values of the current density and the magnetic field. It is a matter of current densities of 10^4-10^5 amperes per square centimeter in a field of 3-5 teslas. However, the achieved current density in bulk materials (10^3 amperes per square centimeter) is affording the possibility of using high-temperature superconductivity in large-scale electrical machine building.

At present superconductor turbogenerators are being developed in the USSR and abroad. The rotor of such a machine has a superconducting winding made of a niobium-titanium or niobium-tin alloy, which is cooled by liquid helium. The stator winding is made of copper and operates at room temperature, therefore, losses of energy remain in it. If the stator winding were produced from high-temperature materials with the same current density as copper has (about 10^3 amperes per square centimeter), the opportunity appears to eliminate the losses in the winding of the stator and to increase by means of this the efficiency of the turbogenerator.

We conducted tests of a superconductor generator with a power of 20 megavolt-amperes and a rotational speed of 3,000 revolutions per minute. Recently experiments, I would say unique ones, on the introduction of this machine in the system of the Leningrad Regional Power Administration were conducted. This is the first test in world practice of a superconducting machine of such power in a power system.

A production prototype of a turbogenerator with a power of 300 megawatts and a rotational speed of 3,000 revolutions per minute was made on the basis of the superconductor generator. A large cryostat was required for static tests of the superconductor rotor. It was ordered and produced in the CSSR. Tests of this turbogenerator on a plant stand of the Elektrosila Electrical Machine Building Production Association imeni S.M. Kirov will begin this year.

Work is being performed on the development of a superconductor stator, which will have an alternating current in the winding of the stator. Wires with exceptionally fine superconducting metal filaments (on the order of several micrometers), around which there should be barriers made of materials with a high electrical resistance, are needed for this winding. All this will sharply reduce the eddy current losses.

A test batch of wires of the indicated type was produced in our country just recently; therefore, at the All-Union Scientific Research Institute of Electrical Machine Building the first electrical machine with a power of 5 kilovolt-amperes with superconducting windings: a direct current on the rotor and an alternating current on the stator, was made. The alternating current winding was made from wires of niobium-tin alloy 0.5 millimeter in diameter with 14,461 filaments 2 micrometers in diameter.

It is quite natural that international cooperation is desirable for the development of new scientific and technical directions. This makes it possible to take into account the experience of other countries. For example, during the development of the superconductor generator with a power of 20 megavolt-amperes the work was organized in accordance with a network schedule of specialists of the All-Union Scientific Research Institute of Electrical Machine Building and specialists of the United States. They reached an agreement on the magnitude of the power of the generator and shared scientific concepts, methods of calculations, and results of tests of the individual assemblies. Discussions took place alternately in the United States and the USSR. The pilot

works of the All-Union Scientific Research Institute of Electrical Machine Building produced the indicated machine 2 years earlier than in the United States.

Vinogradov Remarks on Information Science

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[Speech by Academician V. A. Vinogradov at the Annual General Assembly of the USSR Academy of Sciences on 12 April 1989 under the rubric "The Annual General Assembly of the USSR Academy of Sciences"]

[Text] The problem of the spread of information technology in scientific research at the academy and of the development of information bases and information networks was named among the most important, but still unsolved problems that were posed yesterday by the president of the USSR Academy of Sciences. I want to share the experience in this area as applied to the social sciences. In our opinion, it is of academywide importance.

In December of last year, the Interdepartmental Commission under the chairmanship of Academician G.S. Pospelov accepted for industrial use the automated bibliographical and factual data bank on the social sciences, which was developed at the Institute of Scientific Information on the Social Sciences of the USSR Academy of Sciences.

An important stage of the work on the creation of an information network on the social sciences has been completed. Its bibliographical databases contain more than 1 million documents, and today more than 120 organizations, including 25 foreign organizations, are using this information via telephone communication channels. A technology of the mass processing of domestic and foreign literature, on the basis of which about 1,000 documents are entered daily in the databases, has been developed.

Thus, the annual increase of the amount of information in the database comes to 200,000-220,000 documents. On this basis the preparation and publication of 30 monthly bibliographical indexes on all fields of the social sciences and individual problems, the selective distribution of information, the dissemination of information on magnetic tapes, the performance of one-time and retrospective retrievals in accordance with the orders of clients, the access of users to the databases via telephone communications channels, and the provision of copies of journal articles on paper or microfiches are being carried out. The ordering of copies is made over voice channels in the process of working with the databases.

Difficult organizational problems of the interaction of information centers and scientific institutions for the social sciences were solved. The filling of the databases is being carried out not only by the forces of associates of the Institute of Scientific Information on the Social Sciences—institutions of the Social Sciences Section, particularly the Institute of World Economics and International Relations, the Institute of the United States of America and Canada, the Institute of Latin America, and the Institute of Oriental Studies, are also taking part in this.

The information centers of the academies of sciences of the Ukraine, Belorussia, Georgia, Latvia, and Estonia, the regional centers in Leningrad and Saratov, as well as the centers of scientific information on the social sciences of the fraternal socialist countries are actively participating with the Institute of Scientific Information on the Social Sciences of the USSR Academy of Sciences in the matter of developing the automation of information processes.

Throughout the Soviet Union and the socialist countries more than 10,000 specialists, to whom information about 1.2 million documents was issued in 1988 alone, are covered by all types of information service. The reporting data received from all user organizations confirm this.

During 1977-1988, the majority of institutions of the Social Sciences Section began to use personal computers as remote user terminals. At the Institute of Scientific Information on the Social Sciences an educational center for scientific associates on the use of personal computers was established. For 2 years more than 400 people have been studying here.

We are establishing the first international database on the social sciences. This work is being performed jointly with the the Academy of Finland and the University of Helsinki on the problem of Finno-Ugric studies. Its task is the preparation of a bibliography on Finno-Ugric studies for 70 years, starting with 1917. In 5 years four volumes should be published in seven books. I can already show the first volume "Arkheologiya" [Archeology]. The same volume has also been published in Finland. The Finnish side regards this project as the most important one in the area of the social sciences in all the time of the existence of international relations between the USSR and Finland.

In August of this year, the Finnish side is organizing an international symposium, at which the question of the joining of other countries in this project will be discussed. All this means that we have an actually operating technology of mass information processing and the corresponding databases, which are of not only domestic, also international importance.

The quality of the databases is not inferior to foreign ones. The ever increasing demand on the part of western countries testifies to this. Thus, we already have partners in Austria and Finland, with whom we are carrying out

the exchange of information over communication channels. Moreover, requests on cooperation have been received from Denmark, France, the FRG, and the United States.

Therefore, the statement of prominent scientists and executives, which recently appeared in the press, that in the USSR there are no data banks, evokes surprise. The problems lies in something completely different: the necessary computer hardware, which ensures the reliable storage and extensive use of many millions of databases, is not available, there are no communication channels and means of the simultaneous access to them of a wide range of users. I do not have time to dwell further on these problems. We are glad to receive at our institute representatives of the institutions which would like to familiarize themselves with our work experience.

I want to use the remaining 3 minutes for the raising of the question of the disastrous situation of the library of the Institute of World Literature. This is not a new question. Since 1979 it has been discussed on about 15 occasions in one form or another in the Presidium of the Academy of Sciences, but thus far has not been settled. The library is in catastrophic condition. It is housed in unadapted premises 4.5 meters high, where the books, which lie on shelves, come to the ceiling. It is possible to pass between the shelves only with great difficulty. It is also possible to add much more to this. In short, it is absolutely necessary to transfer the library to new premises.

Of the proposed versions the proposal of the housing cooperative of the Presidium of the USSR Academy of Sciences—to build a new cooperative house with built-in and built-on premises for the library with an area of 5,000 square meters—proved to be the most acceptable and interesting one. There is the agreement of the Moscow City Soviet, which was supported by a decision of the Glavarkhitektura, the "go-ahead" was received from the Academy of Sciences in the person of Vice President K.V. Frolov and former Administrator of Affairs G.A. Chakhmakhchev, a construction organization was found. Everything, it would seem, is fine. But then the new administrator of affairs arrived and began to try to prove the inexpedience of such a decision, because during the next five-year plan an apartment house should be built on this site. The line of reasoning is confined to a reference to a decree of the government, moreover, one that seems to have just been issued. When we looked into things, it turned out that it was adopted in December 1973, but thus far this site has not been developed. And here they are not letting a good job be done. I turned to you, Guriy Ivanovich, twice on this matter. I am now turning to you a third time. I hope that this important problem will be solved. We have a construction organization that is willing to sign a contract on the turnkey delivery of the house within 1 year. And if the question had not been dragged out, at the end of this year we would have already received both a cooperative house and premises for the library.

Aganbegyan Remarks

907A0004K Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 8, Aug 89 pp 88-89—FOR OFFICIAL USE ONLY

[Speech by Academician A. G. Aganbegyan at the Annual General Assembly of the USSR Academy of Sciences on 12 April 1989 under the rubric "The Annual General Assembly of the USSR Academy of Sciences"]

[Text] I agree with the statement of Academician T.S. Khachaturov and would like to provide information on two questions. The first is on the Baykal-Amur Railway Line. Now 7.9 billion rubles have already been spent on the Baykal-Amur Railway Line, while the total estimated cost comes to 10 billion rubles. The railroad has not been put into permanent operation over its entire length, and for that reason two pair of trains are running over it. Thus far temporary traffic has been started on several sections of it. As soon as the railroad is placed into permanent operation, the volume of traffic, first of all through traffic, will increase, since Sakhalin Island and the northern regions of the Far East will be supplied from the Baykal-Amur Railway Line (via the port of Vanino). The through traffic will then increase by approximately tenfold, while the transportation cost will decrease, according to the estimates of specialists, to one-fifth.

Recently at a meeting of the Commission of the USSR Academy of Sciences for Transportation, we discussed this problem in detail. There are no grounds to speak of the inefficiency of the Baykal-Amur Railway Line. One must not keep half the country hanging on one railroad thread, which links the Far East and Eastern Siberia with the other regions of the country. This is incorrect strategically and absolutely unfounded from an economic point of view.

Now about the remark on the Tyumen petrochemical complexes. A group of academicians addressed to the USSR Council of Ministers a protest against their construction on such a scale. Now the position on this issue of the USSR Ministry of the Petroleum Refining and Petrochemical Industry (the head organization) and the Bureau of the USSR Council of Ministers for the Fuel and Power Complex has changed. The preliminary decision was made to assimilate not 40 billion rubles, but approximately 5 billion rubles, and to build these complexes not in the Far North, but first of all in Tobolsk. At the same time it is also important to understand that it is impossible to develop the national economy of the country without the increase of the production of plastics and that the best site for the construction of plants of organic chemistry is Western Siberia. It is economically more advisable to export polypropylene (it is tenfold more expensive than petroleum) and not to continue to export crude oil. It is clear that the operation of the

complexes should be organized so as not to incur unnecessary expenses, without megalomania and the pollution of the natural environment.

Neporozhniy on Energy Situation

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[Speech by Academician P. S. Neporozhniy at the Annual General Assembly of the USSR Academy of Sciences on 12 April 1989 under the rubric "The Annual General Assembly of the USSR Academy of Sciences"]

[Text] The state of affairs, which has formed in power engineering, is such that for its rectification it is necessary to unite the efforts of machine building scientists, geologists, biologists, seismologists, and so on. There are a large number of problems that require special examination by the Presidium of the USSR Academy of Sciences. Such attention toward power engineering is dictated by the fact that it, like no other sector, is most closely connected with technical progress and the increase of the national income. Life is posing the task to ensure a 5-6 percent annual increase of electric power, and it is necessary to strive for this. For the present we are not prepared to ensure such an increase of electric power generation.

What has happened? Nuclear power engineering is experiencing serious difficulties. Now, following Chernobyl, all major nuclear construction projects have been halted until new, safe reactors are developed. For the present we do not have them. Design proposals on the surveying of sites for the construction of nuclear power plants have also not been drawn up.

I will recall that the government posed the task to us as follows: the development on the basis of domestic and advanced foreign know-how of reactor units and nuclear power plants of a new generation with improved characteristics and reliable equipment safety.

The Academy of Sciences should devote increased attention to the scientific and technical problems of the further development of nuclear power engineering.

The holding up of the construction of nuclear power plants, which are located in the European part of the USSR, is leading to the disruption of the normal power supply of the national economy in this region. What is the way out of the formed alarming situation in the development of power engineering? It is first of all the speeding up of the construction of coal and gas-powered thermal electric power plants, as well as the development of water power. We have the largest sources of water power in the world. We have learned to build first-class hydroelectric power plants and are building many of them abroad. So why not build them in our own country? The opponents of hydroelectric power plants say that they do great harm to nature and the population. But if hydraulic structures are managed competently, without using assets too sparingly for nature conservation, it is possible to protect the land, the forest, fish, and agricultural production. It seems that it is necessary to speed up the construction of hydroelectric power plants.

The Kansk-Achinsk Fuel and Power Complex should play a special role in the development of thermal power engineering. There is envisaged here the construction of 10 electric power plants with a total capacity of 64 million kilowatts with the simultaneous building of 1,500-kilovolt direct current high-voltage power transmission lines, as well as 1,150-kilovolt alternating current power transmission lines for the transmission of electric power from Siberia to the European part of the USSR (including the Urals). However, the development of the Kansk-Achinsk Fuel and Power Complex is being held up by the necessity to observe ecological norms (nitrogen and calcium oxides). Hence, scientists should be involved in the matter. It is necessary to develop catalysts for the neutralization of the nitrogen oxides. If we ensure the ecological safety of the Kansk-Achinsk Fuel and Power Complex and high-voltage power transmission lines, we will find a means for the generation of electric power and its transmission in large quantities from Siberia to the central regions of the country. It is necessary by 2005 to increase the installed capacity of electric power plants to 600 million kilowatts, of them thermal electric power plants to 300 million kilowatts, hydroelectric power plants to 150 million kilowatts, and nuclear power plants to 150 million kilowatts.

In conclusion I want to say that the question of power engineering has been raised so pointedly at the assembly for the first time. I believe that it is necessary to hold a special session that is devoted to the problems of the fuel and power complex. A law on power engineering is needed.

Paton on Costs of Basic Research

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[Speech by Academician B. Ye. Paton at the Annual General Assembly of the USSR Academy of Sciences on 12 April 1989 under the rubric "The Annual General Assembly of the USSR Academy of Sciences"]

[Text] Many reports, with assertations that we did not have and now do not have achievements in the area of the basic sciences, have been published in recent times. Scientists are also found among the authors of such articles. What is one to say here? It seems that this is an unfounded assertion. Of course, we do have weak points in a number of fields of science, in which we lag

substantially, but it is impossible to be first everywhere. Moreover, it is necessary to achieve the correct international division of labor.

Thus, in what ways are we to make progress? It is necessary to do everything for the elimination of the notorious cliquishness, which, in my opinion, is incompatible with perestroyka. It is important to unite the efforts of academic science and VUZ [higher educational institution] science, which has an enormous potential. Here for the present, in my opinion, there are no series changes. I am convinced that, finally, the close creative union of basic science and applied science, which is being developed at sectorial institutes, is necessary. In spite of the abundance of all kinds of programs, obviously not enough has been done for the unification of our mighty scientific potential. For example, the question of the absolutely inadequate use of the potential of the republic academies was raised at the last, 43d session of the Council for the Coordination of the Scientific Activity of the Academies of Sciences in Novosibirsk, but thus far in practice, in our opinion, nothing has changed.

Let us take the question of the time of the introduction of the achievements of scientific thought. World experience testifies that the sequences customary for us (basic research—applied operations—experimental design development—pilot and only then series production) essentially has already been refuted at the present stage of the scientific and technical revolution. The time factor dictated the necessity of the changeover to a qualitatively different system, of which the simultaneity of the mentioned links is characteristic. Scientists of the Ukrainian Academy of Sciences are striving to take this important trend into account. The policy of the development of goal-oriented basic research, the experimental design and production base, and various forms of cooperation with the sectors of the national economy was adopted. The structure of institutions of the academy was also changed accordingly: scientific technical complexes, engineering centers, and support stations appeared. All this, undoubtedly, yielded a definite impact. However, under the conditions of an economy, which is not oriented toward constant technological modernization, the potentials, which are incorporated in the new structures, could not be fully realized.

Today the conditions of management in the country are changing radically, which, in turn, requires the substantial modernization of the entire range of forms of the contact of science and production. I am convinced that the resolute revision of the policy of state scientific and technical priorities and the creation of effective legal and economic levers of its implementation are necessary. I will explain this with the example of the state program "Promising Materials," which is now being formulated here. Without its implementation technical progress is impossible in all sectors of the national economy without exception.

Much capital, on the order of 90 billion rubles by 2005, including 4 billion rubles for scientific research and design development proper, and 96 billion rubles for the development of the corresponding material and technical base, is required for the implementation of this program. In the USSR State Planning Committee they treated this sum as being stated too high. But in reality it is a question of the creation in the corresponding sectors of industry of fundamentally new capacities for the production of construction and functional materials. It is difficult, of course, to find such money, even with allowance made for the assets being allocated to sectors, but it will be repaid with interest. Calculations show that by 2005 an economic impact in the amount of nearly 250 billion rubles, that is, which exceeds the costs by 2.5-fold, will have been obtained in the national economy. No complex is providing this. If the program is not actually provided with special-purpose capital investments and powerful mechanisms of management, a sad fate awaits it. This must not be allowed.

Now a few words about financing. The new model of the financing of research for all its progressive nature bears the danger of the supplanting of basic science by applied science. The experience of the first months of work in the new way convinces us of the need to retain the nonstandardized budget financing of basic research, and to use standards only in case of the additional financing of competitive projects and for contractual themes. Such an "intermediate" model is especially expedient under the conditions of the significant decrease of the receptivity of enterprises, which have been converted to full cost accounting, to scientific and technical innovations.

The draft of "The General Principles of the Perestroyka of the Management of the Economy and the Social Sphere in the Union Republics" is also raising serious questions. In it, however strange it is, there are no provisions on the statewide importance of basic research and the necessity of its priority development in the union republics. We have already now come up against the tendency for the assets of the union budget to be redistributed arbitrarily at the republic level. Thus, more than 2.5 million rubles were taken from the budget of our academy for the conducting of a republic competition on exclusively applied developments. While starting next year it is envisaged to take away 40 percent. All this, of course, cannot but cause serious anxiety, for first of all the further checking of the development of basic research will be the consequence.

The allocations, which are being earmarked from the union budget, it seems, must be used strictly in accordance with their purpose. On their part the Councils of Ministers of the union republics, in our opinion, should allocate additional assets for the financing of basic research. We ask the USSR Academy of Sciences to submit a proposal on supplementing the draft of "The General Principles" with the corresponding provision.

At the union level the proper unity of approaches and actions when pursuing scientific policy is also lacking.

Let us take the situation with the additional financing of basic research programs of the USSR Academy of Sciences. It is incomprehensible on the basis of what considerations back before the holding of the competition the share of all the regional departments of the USSR Academy of Sciences and the republic academies was limited to 150 million rubles with a total amount of 500 million rubles. As a result only a negligible increase of the financing of scientific programs at the academies of sciences of the union republics occurred.

Moreover, in the corresponding decree of the USSR State Committee for Science and Technology not a word is said at all about basic research programs. There is no uniform interpretation: the USSR Academy of Sciences divided the additional allocations among its programs, while the State Committee for Science and Technology indicated that they should be spent on work first of all on the Comprehensive Program of Scientific and Technical Progress of the USSR, state scientific and technical programs, the unified plans of interbranch scientific technical complexes, and the Comprehensive Program of Scientific and Technical Progress of the CEMA Member Countries. Here the additional budget allocations were appropriated to us for material and technical development without a wage fund.

In conclusion I want to say that the need has arisen to revise the existing practice of getting personal agreement in case of the election of new members of the academies of sciences of the union republics. It developed long ago into a formal, unnecessary procedure. This also concerns getting agreement on the candidates for the positions of directors of scientific institutions. Under present conditions several candidates compete for election to this position. The scientific collective is taking part in their selection. Consequently, the reaching of agreement with the USSR Academy of Sciences is losing meaning.

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